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ABSTRACT

Chapter I of this master's thesis examines aspects of the changing lifestyle that was inaugerated by the Industrial and Scientific Revolutions. Chapter II picks up the transition in general schooling that accompanied the revolutions. Chapter III traces the role of the evolving science curricula in this transition. Chapter IV presents proposals based on the writings of the Baha'i Faith that may be useful in the gradual development of a science curriculum that aids more students to become actively involved in the study of and transmission of practice of science in the schools. (Author/CS)

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AN EXAMINATION OF THE SCIENCE CURRICULUM AS IT REFLECTS SOCIAL/INDUSTRIAL CHANGE: A PROPOSAL FOR CURRICULUM INVOLVING SOCIAL INTERACTIONS AND UTILITARIAN OUTCOMES

by

THOMAS SCOTT SEALE

B.S., Georgia State University, 1977

A Thesis Submitted to the Graduate Faculty
of the University of Georgia in Partial Fulfillment
of the
Requirements for the Degree

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In many ways the completion of this work marks a transition from one phase of life to another. The last several years have been a time of reflection and analysis for me, which followed upon many years of assimilation in and out of the classroom. Hopefully, I am now moving into a period of activity in which I can challenge and refine my thoughts on the battleground so to speak. But before I do this it is only right that I pause for a moment to consider those lives that have encouraged me onward.

For the completion of this immediate work I owe immense gratitude to the patience, warmth, generosity and insight of Professor Russell Yeany, who remained confident in my work in moments when I needed a gentle bolster. I owe thanks to Professor James Okey, for his support and critical review of my work, and to the merciless pen but gentle spirit of Professor Kenneth Ricker.

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INTRODUCTION

> These are not days of prosperity and triumph. The whole of mankind is in the grips of manifold ills. Strive therefore to save its life...
>
> Baha'u'llah

The above quote from the Baha'i Writings expresses one of the principle operating assumptions of this thesis: that the societies of man have strayed far from the path of safety and ecological social development. The state of the societies of man in both the East and the West is unsettled and tottering. In the West it appears we have manufactured and somewhat sloppily erected a society built through and around the generating power of industry and scientific technology. Great advances have been made, but it remains to be seen if we can flourish and grow healthily in the structures that we have constructed. My fear is that we cannot.

One of the structures that we have built in the West is a public education system. In this thesis I will be primarily concerned with the upper secondary and collegiate years of science instruction in these schools. In a rapidly growing technological society such as ours, whose evolution in large part depends on the flow of trained scientists

emerging from the schools, the education accorded the scientist may heavily determine the nature of the society that is built. I have one major complaint: the nature of science instruction at this level of schooling is so narrow and unattractive to a majority of students that only a very few students are able to persist in the study of science. My thesis is that one of the ways the instruction of science frustrates the learner in upper secondary and college science courses is that this instruction is almost totally removed from the arena of utility--the content of science instruction does not equip a student with knowledge that he can use to shape his world. The pursuit of science in these adolescent and young years of adulthood is almost totally bound to the study of words and the repetition of acts (such as in school laboratories) that can be applied in only the most limited sense to real world concerns.

If the student perceives this to be so it is only natural that his interest in science will wane. This situation may have profound social consequences. The science courses in the schools may be operating as a sieve to sort out the few who will go on to become the fashioners of the technological society, from the many who may be forced to become the subjects of the society designed by the few. This is especially so if the subjects taught in the schools have no applied relevance, no immediate utility for the students, and merely lead to even more academic courses which eventually lead to some level of application for those few

students that persist. Yet students are forced to accept this narrowed academic presentation of science as the only option available to them in most public high schools and colleges. This might not be a bad situation if both the few and the many were functioning creatively and happily in their roles and if there was evidence that the fashioners were fashioning wisely. However, evidence is that they are not.

This work will trace in three chapters the historical development of this current classroom malady. Chapter I will examine aspects of the changing lifestyle that was inaugurated by the Industrial and Scientific Revolutions. Chapter II will pick up the transition in general schooling that accompanied the revolutions. And Chapter III will trace the role of the evolving science curricula in this transition.

Mankind is not scratched, he is deeply wounded. Yet in his bleeding it appears that the faculties of man to respond to his crisis have dimmed. His reasoning power, his compassion, his volition, and his ability to take unified action have all faded. Physicians are everywhere busy shouting remedies, but none are able to agree upon and successfully administer one. It is for these reasons that writers like Jung, Fromm, Mumford, Henry and others feel that the West is in a spiritual crisis. It is a crisis in the heart and soul of man. Yet no contrived religious potion will be effective. Mumford (1970) writes; "For its effective salvation mankind will need to undergo something like a spontaneous religious conversion" (p. 413).

The proposals presented in Chapter IV revolve around my understanding of some of the Writings of the Baha'i Faith; a religion founded in the middle of the ninetheenth century, which disseminated from the Middle East. If the issues that confront mankind in reality reflect a systematic misunderstanding and abuse of certain real, discernable, spiritual laws (laws that govern the healthful development of the civilizations of man), then any analysis and proposed corrective intervention in the problem must attend to the existence and operation of these laws if it is to be successful. In a similar sense I feel that the problems existing in the science curricula are a reflection of the greater spiritual problems existing in the society. I must therefore attempt to identify and address some of these problems in my proposals. The Baha'i Faith enumerates these laws and the processes necessary for a spontaneous religious conversion which effects the hearts and societies of man (see World Order of Baha'u'llah, by Shoghi Effendi).

I do not feel that intervention in the classroom problems can be successful without systematic, organic, natural evolution within the total community. Therefore, I do not think the proposals of Chapter IV can by themselves prove an effective panacea for the science classroom maladies. Nevertheless, it is my hope that the proposals may be useful in the gradual development of a science curriculum that aids more students to become actively involved

in the study of, transmission of, appreciation of, and practice of science in the schools.

CHAPTER I

THE SCIENTIFIC AND INDUSTRIAL REVOLUTIONS: THE INVERSION OF A LIFESTYLE

The Renaissance gave birth to twin sons: the Industrial Revolution and modern science. Through these sons a profound social revolution was worked on the prevailing village culture as both the content of the villagers activities and the physical structures that define and constitute the elements of village culture began changing. The result was that the older, more stable but staid elements of village culture that had been built upon the foundations laid in the ancient agricultural revolution, were now being swept away by these new, more powerful revolutions and were being replaced by those physical and social structures that are now the more familiar forms of Western culture.

Though brother science and brother industry were close childhood playmates, it was the young son industry who, first in England, and then throughout the rest of the world, rose to maturity and began placing his mark upon the physical structures of the prevailing society. As noted by Jacob Bronowski (1973), in his masterly work, The Ascent of Man, the Industrial Revolution was in reality a social revolution and the English mechanism for accomplishing the social

changes attempted by political means in America and France. It was a social revolution because changing the mode of production had the effect of changing the pattern of life that had evolved over the centuries in the English villages. It was a very powerful revolution as evidenced by the fact that it spread very rapidly, and ultimately extended throughout the Western world. Bronowski (1973) notes:

> Within two generations, roughly between 1760 and 1820, the customary way of running industry changed. Before 1760, it was standard to bring work to villagers in their homes. By 1820, it was standard to bring workers into a factory and have them overseen (p. 260).

If we take Webster's (1970) New World Dictionary date of 1760 as a starting point for the Industrial Revolution, we can see that it has taken a little over two hundred years for the revolution to overturn the existing village culture then common to Western man and to completely change both the physical structure of Western society and the activities of its people. It is clear that the day-to-day behavior of an average citizen of two hundred years ago is vastly different from that of the average citizen of today. As the Industrial Revolution has progressed, this has become true not only for the city dweller but for those working on rural farms as well.

While I do not wish to enter into a lengthy discussion concerning the pros and cons of this revolution, I do wish to ferret out two changes that have occurred in this transition from a predominantly village culture to an industrial one.

One of these changes is the degree of interaction that the common man of today has with his environment contrasted against the amount of environmental interaction typically engaged in by pre-industrial man. The other change I wish to look at is the apparent change of personality of man in this transition. I will eventually relate both of these concerns to the development of a modern day science curricula.

Environmental Inversions

The agricultural revolution of 12,000 years ago permitted the gradual formation of a pyramid-like occupational structure (see Figure 1). Throughout the Middle Ages and into the Renaissance most people were engaged in and dependent upon working the land or its products for survival. Accordingly, I have termed the interactions of the bulk of the people, which corresponds to the large base of the pyramid, "ground level product" interactions. However, the bounties of the agricultural revolution did allow some of the people to escape indefinitely the necessity of working directly with the earth's products, and in favorable years many people enjoyed enough leisure time to result in a flourising arts and crafts economy. This increased freedom from ground level interactions granted to some of societies members, is represented by the narrowing apex of the occupational pyramid.

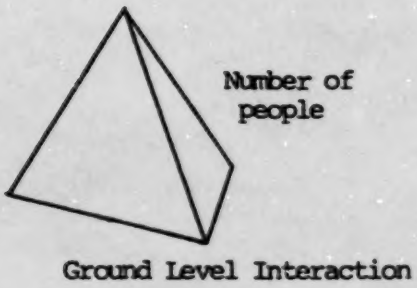


Figure 1. Occupational structure pre-1760.

I wish to stress two important characteristics of ground level product interactions in village culture. One is the near universality of cultures whose citizenry were primarily engaged in ground level interactions up until the time of the industrial revolution--a fact that indicates the stability of this occupational way of life. The second characteristic is the remarkable diversity of artistic and cultural expression that flourished in these cultures--a fact that indicates the adaptability of this occupational way of life to the creative needs of man.

Lewis Mumford (1967) in his analysis, Technics and Human Development, notes the neolithic origin of village culture. He writes:

> Wherever the seasons are marked by holiday festivals and ceremonies: where the stages of life are punctuated by family and communal rituals: where eating and drinking and sexual play constitute the central core of life: where work, even hard work, is rarely divorced from rhythm, song, human companionship, and esthetic

> delight: where vital activity is counted as great a reward of labor as the product: where neither power nor profit takes precedence of life: where the family and the neighbor and the friend are all part of a visible, tangible, face-to-face community: where everyone can perform as a man or woman any task that anyone else is qualified to do--there the neolithic culture, in its essentials, is still in existence, even though iron tools are used or a stuttering motor truck takes the goods to market (p. 158).

In cultures like these, man has risen to a height and variety of incredibly rich artistic expression. It would be a misconception to believe that these cultures did not lend themselves to innovation or creativity, when all of revered art, all of valued architecture, all of the beloved poets and musicians, most of what we cherish as folk culture --the dance, song and costume, the most spectacular of philosophers and brilliant of inventors; save for those that have been produced in the mere blip of the last two hundred years, have lived in these neolithic, village-like cultures where people engaged in work with the earth and her unrefined fruits.

The men of these days were essentially primary producers--obtaining a resource from close to its origin in the earth and manipulating it to a completed product. Mumford (1967) has termed this a "polytechnic" economy. It was an economy based more on the pride of craftsmanship and the ethics of trade than we are today accustomed to. The modern day psychoanalist/social psychologist Erich Fromm (1955) notes that: "... it was supposed to be un-Christian and unethical for one merchant (of the seventeenth and eighteenth century)

century) to try to lure customers from another by force of lower prices or any other inducement" (p. 81). Fromm (1955) quotes from a 1745 edition of the Complete English Tradesman, "this underselling practice is grown to such a shameful height, that particular persons publicly advertise that they undersell the rest of the trade" (p. 81). One of the unique stabilizing characteristics of village life was the concern of the citizenry to protect the structure and values necessary for maintaining a viable community life. In the terminology of the German sociologist Ferdinand Toennies the pre-industrial villagers were more concerned with the values of community living--"gemeinschff", as oppossed to the transcendant social values of "gesellschaft". Oddly enough this great asset of village culture also became its most potent flaw, and was the weakness that the industrialist would soon exploit. Mumford (1967) notes:

> In short, the neolithic village community had to pay the penalty for its success: its own virtues arrested it. The horizon was too confined, the routine too limited, the religion too closely bound to petty ancestral gods, the village itself too complacent in its isolation, too narcissistic and self-absorbed, too suspicious of the stranger, too hostile to invading customs--its little local good a stubborn enemy to any foreign best. Even the language of such villages tended to become so inbred that a local dialect might be unintelligible a day's walk away. In surviving tribal communities all these vices have become ingrained by five thousand years of repetition and protective isolation and perverse elaboration: the creative moment has long passed (p. 162).

I will draw on an analysis of these strengths and weaknesses in the consideration of science curricula in Chapter IV.

The Fuel of Invention: Sincere Intention and Avarice in Industry

A curious combination of people and character traits fueled the Industrial Revolution. As Bronowski (1973) notes, it was the construction in England of the canal system, an innocent enough invention, that really initiated the vast social changes that were to follow. The canals in linking the countryside and major cities made possible the rapid and direct transport of produced goods; thereby opening up new markets and igniting the interest of industrialist and inventor alike.

The men who were the leaders of the Industrial Revolution can be viewed in two contrasting lights. Both views are helpful in establishing an accurate historical perspective of the time. Bronowski (1973) writes:

> The men who made the Industrial Revolution are usually pictured as hardfaced business men with no other motive than self interest. This is certainly wrong. For one thing, many of them were inventors who had come into business that way. And for another, a majority of them were not members of the Church of England but belonged to a puritan tradition in the Unitarian and similar movements (p. 274).

Bronowski is concerned that we realize that many of these men were religious men fondling new found ideals such as "social responsibility." Many industrialists were concerned with liberating people from their pitiful enslavement

to conditions of dirt, disease and hunger. These industrialists spoke of a new "wealth of choice" that could be offered to the common man in terms of obtainable conveniences. These same arguments can be heard throughout the camps of the industrialist/inventor of today.

The opposing view is perhaps best illustrated by Mumford (1970) in his book, The Pentagon of Power. He writes:

> But what shall we say of ..., the systematic craft-wreckers, of the machine: the ruthless enterprisers who, during the last two centuries, have in effect confiscated the tools, destroyed the independent workshops, and wiped out the living traditions of handicraft culture? What they have done is to debase a versatile and still viable polytechnics to a monotechnics, and at the same time they have sacrificed human autonomy and variety to a system of centralized control that becomes increasingly more automatic and compulsive. If, two centuries earlier, they had fully succeeded in extirpating the handicraft traditions of the primitive peoples, rubber would not play the part it now does in our advanced technology. Were these craft-wreckers afraid to let handiwork survive lest it join forces, against their financial interests, with the human heart? (p. 153).

And so it happened that some men of good intentions, and perhaps others of not so noble regard were able to completely rearrange what had for thousands of years been the stable cultural pattern for most of the civilizations of man. This occurred as the village communities lost the ability to control the rate of change precipitated by the rapid influx of goods produced from afar. Craftsmen were driven out of business by the hundreds, but the people did gain a new wealth of choice. A country of villages was welded into a world of metropolises, and the world began showing traces of an economic unity between countries. But something precious

had been lost--the freedom of the man engaged in self-directed creative work. Man began to move farther and farther away from the direct ground level interactions of a primary producer. More and more his relationship with the earth's products was governed and restricted by industrial forms. For many, work became personally meaningless to the creative side of his nature as the worker conformed himself to the call of the machine. Mumford (1967) observes:

> As work begins to disappear in our society under automation, and the daily grind becomes personally meaningless, we shall perhaps for the first time realize the part that neolithic culture played in the humanization of man (p. 141).

Bronowski (1973) also notes the introduction of the hidden evil behind the gem of production:

> ... the factory system was ghastly; the school books are right about that. But, it was ghastly in the old traditional way. Mines and workshops had been dank, crowded and tyrannical long before the Industrial Revolution. The factories simply carried on as village industry had always done, with a hearty contempt for those who worked in them.
>
> The new evil that made the factory ghastly was different: it was the domination of men by the pace of the machine. The workers for the first time were driven by an inhuman clockwork: the power first of water and then of steam. It seems insane to us (it was insane) that manufacturers should be intoxicated by the gush of power that spurted from the factory boiler without a stop. A new ethic was preached in which the cardinal sin was not cruelty or vice, but idleness. Even the Sunday schools warned children that
>
> Satan finds some Mischief still
> For idle Hands to do. (p. 279-280)

Today the occupational pyramid is inverted in relation to ground level interaction, as represented in Figure 2. Very few people are involved in actual ground

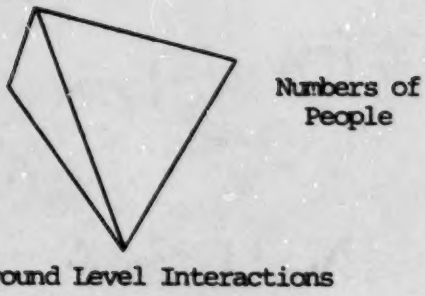


Figure 2. Occupational structure today.

level interaction with the natural environment, and even fewer people are afforded the luxury of operating as a primary producer. Even the farmer, who in the past has been the preeminent symbol of a man who works the earth, is today far removed from any such historical ground level interaction. As he rides his air conditioned, radio equipped harvester to gather his crops, only his tractor is engaged in interaction with the earth. I am not arguing that primary production is a necessity or even necessarily desirable, but rather am calling attention to the degree of our occupational inversion away from the ground level product interactions. This is a very radical step for mankind to take. The style of life that evolved out of the rapid expansion of the Industrial Revolution, and that resulted in removing the bulk of people from contact and personally directed

meaningful interaction with the products of the earth, must be regarded as experimental.

The verdict of the stability of a society based on an inverted pattern of the traditional organization of man's relationship to his environment is still out, but I will presently present evidence that our modern society rests on shaky foundations, and that the present science curricula so often found in the upper secondary schools and colleges, may actually favor an impending collapse of the prevailing Western social order. If the schools and the science curricula of the schools continues to deny the populace, as most of the occupations of the West seem to, an opportunity to learn to direct, control and create personally meaningful work which has activity in the social worlds of man; then educators run the risk of attempting to establish a society upon ground that is historically unproven for the psychic stability of the soul of man. However, before I continue with this argument I need to reintroduce brother science into the scenario and trace his effects upon the pattern of evolving society and the personality of modern man.

Brother Science

Brother science matured later than brother industry, and was slower to make his mark upon the physical structure of society. Yet it seems that it is brother science who is more with us these days. Rumblings of the birth of modern sciences in the West extend back to Copernicus (1473-1543),

though it is Galileo (1564-1642, who is generally credited for inaugurating the notion of a "scientific" method. This method involved knowing a thing principally through its primary qualities. If industry was a child who said little but did much; science was a child who talked incessantly, but to whom no one would listen. This is not true in recent times, as brother science has more than demonstrated that he can change the world through his quiet rumblings.

From the beginning, science was more concerned with the elusive nature of truth than the industrialist/inventors. This interest was a cause for great concern to the cultural elders of young science. It must not be forgotten that the world did not accept with open arms the thoughts of many of science's first philosophers. Galileo was forced to recant his heretical notions that the earth was not the center of the universe, was twice threatened with torture, was publicly humiliated and ostracized. The clergy clearly saw that this new scientific method of explaining things had aspects of an ideology as well. The trouble with this new "scientific" objectivity was that it held out for the existence of laws of higher mathematical order; higher that is than the authority of the Church didactics. In Galileo's case the Church didactics happened to include the Pope Urban VIII himself.

As with the Industrial Revolution, the application of the scientific methods produced mixed blessings in the contemporary society. The peoples' thoughts, wrapped in

thick clouds of dogma and chained to religious superstition, suffered from the same staidness that made their village culture susceptible to the industrialists' leaven. Intellectually the climate of the Middle Ages was frozen when it came to matters of potential Church concern. Imagine Galileo's delight, yet frustration as he tried to explain his findings to a curiously cautious world. Galileo, writing to his friend Kepler, in a reference given by Mumford (1970) said:

> Oh my dear Kepler, how I wish that we could have one hearty laugh together! Here at Padua is a principal professor of philosophy, whom I have repeatedly and urgently requested to look at the moon and planets through my glass, which he pertinaciously refuses to do (p. 61).

As Mumford (1970) relates, this was a time "when conversation had become impossible between a Catholic and a Protestant, or for that matter, between the adherents of two different Protestant sects" (p. 73). The social value of the scientific method then was that

> this new mechanical idology performed a unique service: it provided a common language and it opened upon a field of practical endeavor in which people with widely different inner worlds could nevertheless collaborate (p. 73).

However, just as there was a hidden danger in introducing new forms of production which once unloosed could not be controlled by the social institutions of Medieval man; the scientific method concealed an interest which was not totally earthly--that was not concerned as much with the milieu of man, as with the hidden secrets of

nature. The spirit of science was often perceived as a conquering spirit. Mumford (1970); quotes Descartes (1596-1650) as saying:

> I perceived it to be possible, he observed, to arrive at knowledge highly useful in life; and instead of the speculative philosophy usually taught in the schools, to discover a practical (method) by means of which, knowing the force and action of fire, water, air, the stars, the heavens, and all the other bodies that surround us, as distinctly as we know the various crafts of our artisans, we might also apply them in the same way to all the uses to which they are adapted, and thus render ourselves the lords and possessors of nature (p. 78).

Mumford notes this desire "to become lords and possessors of nature, was the ambition that securely united the conquistador, the merchant adventurer and banker, the industrialist and scientist...." It is this same spirit of conquest that was to later sweep into America, subdue it and build its big cities. However science suffers from the same problem of paradigm that village culture did: its greatest strength is also its greatest flaw. In pursuit of "objective" science the young scientist tried to eliminate as much as possible of the contamination of man's subjective influence on a problem so that the investigation could proceed logically and mathematically. However, in attempting to eliminate man's subjective nature from consideration, the scientist ran the risk of creating in an abstraction where man does not live--contemplating in a void that is divorced from man's real subjective cultural world.

Science was relatively harmless as long as it dealt with concerns of pure mental abstraction, however the beauty

and force of the pursuit of science is that in many instances it proved to be a very short jump from the drawing board or laboratory bench to the industrial workshop, and thence to the market of society. But the primary concern of the scientist and the industrialist was not with the social consequences of their endeavor when unleashed into the world of men. Their concern was more of the practical consideration of the actualization of an idea or the possibility of a market. Science like industry erupted as a conquering force. The scientific quest to become "lords and possessors of nature," as expressed by Descartes, represented an essentially male pursuit. It lacked the corresponding half of man's feminine qualities. It thrust out into the world of the unknown, but harbored a potential juggernaut in disguise. It captured man's explorer nature, but abandoned his home life and ignored his need to maintain a stable community and ornament it with his love.

As village life, which had held man's scientific interest close to the ground and to the needs of the community, began to whither away, the arm of scientific endeavor was allowed to probe with unattached abandon from the body of the general concerns of mankind, and tamper with the more Faustian powers of the world. Many scientists set out to conquer nature and discover her secrets, and protected under the banner of "scientific objectivity" began exploiting first the physical manifestations of power and then the chemical ones. However, the products of such "objective"

searches increasingly found their way into the world of men, as did the products of industry, and forced an alteration in the culture of Western man. The danger of scientific pursuit was in the existing social institutions lack of control over the application of science, and their inability to direct the attention of the scientist to more popular concerns. A similar argument can be made of the scientists' pursuits today. If science can proceed as if in a vaccuum, creating its own ontology and reason for being, ignoring the organic needs of the body of mankind, being prone to receive orders from a self-seeking brain, and often linked to the captains of industrial business then we have created a dreadful monster.

There is one other important concern to note in the transformation from village to industrial life as it relates to science, and that is the changing character of the practice and application of science. The scientist of antiquity and of the early scientific revolution was, like other craftsmen, very nearly a primary producer. He worked with simple tools, often constructed by himself or with the help of friends. He was engaged in every step of his research project, and could shift his attention as he saw fit. The scientist of today can rarely make such a claim. Mumford (1970) relates:

> The corporate scientific personality has thus taken over the attributes of the individual thinker; and as science comes more and more to rely for its results upon complicated and extremely expensive apparatus, like computers, cyclotrons, electronic microscopes,

> and nuclear piles, no work along present lines can be done without close attachment to a well-endowed corporate organization. The dangers that this technological advance offer to science have not yet been sufficiently canvassed; but in the end they will perhaps nullify no small part of its benefits and rewards (p. 113).

One result for modern man of this expanding relationship between the brothers of science and industry is an increased sense of the loss of control over one's life, a theme I will expand upon in the next section. For the scientist a considerable amount of freedom has been lost in his ability to direct his own research as such research, dependent on machines of considerable expense, is partially determined by the interest of large institutions. For the average citizen the feeling of helplessness in the grip of scientific "advancement" may be paralyzing as the citizenry is forced to watch spellbound as their world is transformed in front of them. Social commentator Archibald MacLeish (1968) observes:

> Technology, our grandfathers said, "advanced" and it was literally true: it was technology which was beating the tambours, leading the march. Buildings crowded into the air not because their occupants had any particular desire to lift them there, but because the invention of electric elevators and new methods of steel and glass construction made these ziggurats possible and the possibility presented itself as economic compulsion.
>
> Wildness and silence disappeared from the countryside, sweetness fell from the air, not because anyone wished them to vanish or fall but because throughways had to floor the meadows with cement to carry the automobiles which advancing technology produced first by the thousands and then by the thousand thousands (p. 14).

The Changing Personality of Man

All of this rearrangement in the societies of man could not help but have effects upon the character of man. With the noise and clamor of industrial success, new age builders burroughed beneath the feet of the ancient culture on which man stood, and shot magnificent structures into the air before and around him. Small communities melted into the arteries and veins of larger ones, and had to reorient their functioning to fit a changing world order. As older living patterns became difficult to maintain, new laws of social operation had to be constructed, and man had to relearn what living meant. The pattern of life associated with primary production was subdued and replaced by one in which work was associated with mass production and the worker worked for wages that would enable him to purchase other mass produced goods. These changes occurred most quickly in America, which did not have the degree of invested culture to be overturned. If workers could survive and accept the changes in daily routine, the vanishing community and the loss of self direction as a necessary payoff to the greater goods of increased regularity of income, a growing sense of nationality, and increased choice of consumption, it was an incredibly exciting time in which to live. The concept of a larger less local society grew and became associated with the production and free transport of a multiplicity of goods; and the American way of life was born. However, by the early 1800's

it was apparent to some that all was not well in America. In 1831-1832 Alexis de Tocqueville, the scholarly observer from France, visited America--the transplated hub of growing mechanization--and made these observations:

> Above this race of men stands an immense and tutelary power, which takes upon itself to secure their gratifications and to watch over their fate. That power is absolute, minute, regular, provident, and mild. It would be like the authority of a parent if, like that authority, its object was to prepare men for manhood; but it seeks, on the contrary, to keep them in a perpetual state of childhood.... (Mumford, 1970, p. 345)

While it is comparatively easy for us to see that most traces of village culture and primary production have evaporated in the heat of urbanization and industrialization in America, and acknowledge that these changes may have some effect on the American (or Western) personality; it is more difficult for us to imagine how it is that we may have changed, or how to gauge the relative health of our adjustment. Every Westerner we meet in some degree reflects the same culture that we are ourselves a part. For this reason it is important to attend to statements made by non-Westerners, and to engage in a little healthy introspection in as much as our rapidly changing Western culture is really an experiment in the life of mankind.

De Tocqueville seemed to have witnessed a negative social effect arising from the new forms of production. He saw that a society that attempts to supply everything and entertain every new desire is as apt to fall victim to its own desires as a child with a dollar in a candy shop with

no parent around. However, if industry has supplied the worker with a healthy wage it cannot stand idly by while the worker spends that wage. Instead, like a greedy candy store owner, industry must constantly lure the workers to buy. The economist John Kenneth Galbraith (1971) in his book, The New Industrial State, writes, "High production and income ... remove a very large part of the population from the compulsions and pressures of physical want. In consequence their economic behavior becomes somewhat more maleable" (p. 24). Galbraith recognizes the industrialist assault on the will of man. He continues, "It is the sound instinct of conservatives that economic planning involves inevitably the control of individual behavior" (p. 40). The effect of all this is rather like an organized attack upon the soul of man that employs every means of influence possible. Galbraith (1971) notes, "... management (of individual behavior) requires extensive access to means of communication, newspapers, billboards, radio and t.v. To insure attention these media must be raucous and dissonant" (p. 286).

Not only does the individual come under attack as corporations compete for his buying power, but as the soul of man is won over to the sweet taste of thoughtless consumption a peculiar social addiction arises in the masses of people. People begin to feel the psychological compulsion to have what they have become used to even if it is bad for them. In society itself there arises the organized cry for more growth, more expansion, for larger candies and bigger

money making machines so people can buy all the sweet things. This unsatisfactory condition is often called "progress" in our modern society. Galbraith continues, "The economy for its success requires organized public bamboozlement" (p. 286). If this is so then we may all have been bamboozled. We are therefore justified in asking as psychologist Erich Fromm (1955) does, "Are we sane?" Has man preserved in all this social upheaval his mental health? Or are we unable to perceive our sickness as everyone around us is in some degree also blinded by the same sickness. The answer depends on how we define mental health. Fromm (1955) notes:

> ... mental health cannot be defined in terms of the "adjustment" of the individual to his society, but, on the contrary, that it must be defined in terms of the adjustment of society to the needs of man, of its role in furthering or hindering the development of mental health. Whether or not the individual is healthy, is primarily not an individual matter, but depends on the structure of his society. A healthy society furthers man's capacity to love his fellow men, to work creatively, to develop his reason and objectivity, to have a sense of self which is based on the experience of his own productive powers. An unhealthy society is one which creates mutual hostility, distrust, which transforms man into an instrument of use and exploitation for others, which deprives him of a sense of self, except inasmuch as he submits to others or becomes an automaton. Society can have both functions (p. 71).

If we take Fromm's view, then we have good reason to question our supposed sanity.

Evidence has been amassed by scholars of diverse cultures, that we are not very mentally sound. Cultural anthropologist Jules Henry spent six years studying American culture, and writes in his book, Culture Against Man (1965)

about the mixed blessings of our modern cultural inheritance. I will note only two of his concerns here. One is the growing sense of uselessness found among Americans, a phenomenon that should be of interest to educators. Henry (1965) writes:

> The fear of becoming obsolete is so powerful that the sense of being useless is a common element in emotional crisis in America. However, this fear is rooted not only in the fear of obsolescence, but also in an industrial system that obliges too many people to do what they have so little interest in doing. In this respect America's industrial progress has made many people spiritually useless to themselves (p. 25).

It is my supposition that the American education system in general, and the science education system in particular, is keeping youth caught in this predicament of being useless to themselves. This is true because the American education system grew up in association and cooperation with the American industrial system. This evolution will be discussed in Chapters II and III. In addition, Henry notes (1965) that the changing character of our culture toward Idic drives. He writes, "... the Superego values of hard work, thrift and abstemiousness no longer pay off.... and the Id values of fun, relaxation and impulse release are ascendant" (p. 44). He concludes, "Only a people who have learned to decontrol their impulses can consume as we do."

The symptoms of distress, that Henry referred to, whether in an individual or in a society are more or less direct products of the change initiated by the Scientific and Industrial Revolutions, and a result of the uncontrolled

influence of these agents of change. Let no one suppose that I am condemning science and industry, rather I wish to examine the effects of an almost religious faith in science and technology and how the science curricula operate within this technologically modern society. Today Western man seems to have a technological compulsiveness to tamper with Faustian powers and ride the comet of science and industry to the stars, and this is what I question. Viewed from a different cultural perspective this constant pushiness of Western man may appear quite insane. The famed psychiatrist, Carl Jung (1933), relays the perplexity of an American Indian friend as he observes the Westerners behavior and appearance:

> We don't understand the whites; they are always restless, always looking for something. What is it? We do not know. We can't understand them. They have such sharp noses, such thin cruel lips, such lines in their faces. We think they are all crazy (p. 213).

Jung continues, "My friend had recognized without being able to name it the Aryan bird of prey with his insatiable lust to lord it in every land." Jung (1933) notes the profound consequences such drive has upon the psyche of man. He writes:

> What we actually see is that the Western world strikes up still a more rapid tempo--the American tempo--the very opposite of quietism and resigned aloofness. An enormous tension arises between the opposite poles of outer and inner life, between objective and subjective reality.... (p. 220)

Today, some 200 years removed from the inception of this process, the psyche of Western man is beset with a

unique set of problems. Man seems to be alienated from himself--perhaps living in a culture which is alien to his own well being. Fromm (1955) has called this feeling of alienation, "the central issue of the effects of Capitalism on personality...." (p. 111). He writes:

> Science, business, politics, have lost all foundations and proportions which make sense humanly. We live in figures and abstractions; since nothing is concrete, nothing is real. Everything is possible, factually and morally. Science fiction is not different from science fact, nightmares and dreams from the events of next year. Man has been thrown out from any definite place whence he can overlook and manage his life and the life of society. He is driven faster and faster by the forces which originally were created by him. In this wild whirl he thinks, figures, busy with abstractions, more and more remote from concrete life (p. 111).

This feeling of alienation is to be expected when man has been ripped up from the historically stable roots of ground level interactions. The current society may allow creativity for some, but it relegates many to a passive helpless role--nor does our modern society convincingly demonstrate stability. Instead it seems we constantly stumble on the cliffs of international disaster. Several years ago Willis Harmon (1972) a key futurologist, capsulated eight lead indicators of revolutionary social change which illustrates this instability. This list is presented in Table 1.

In the following chapters I will trace the role of the school, in this existential milieu and question whether the science curriculum adequately addresses the needs of modern man.

Table 1

Lead Indicators of Revolutionary Change*

Decreased sense of community
Increased sense of alienation and purposelessness
Increased occurrence of violent crime
Increased frequency of personal disorders and mental illness
Increased frequency and severity of social disruptions
Increased use of police to control behavior
Increased public acceptance of hedonistic behavior
Increase in amount of noninstitutionalized religious activities

*Indicators taken from Harmon, 1972, p. 31.

CHAPTER II

THE SCHOOLS IN THE WEST'S CHANGING CULTURE

The Two Types of Schooling

In this chapter I wish to briefly consider the nature of schooling before and after the Industrial and Scientific Revolutions. In most societies there coexisted two forms of schooling prior to the revolutions. I shall refer to one of these forms as "natural" schooling and the other as "academic" schooling. The function of each type of schooling was unique; both were useful. Natural schooling was found in all preindustrial societies. A natural school served to train youth in those general skills that were necessary to the acquisition of the basic elements of a culture. The concern of natural schooling was practical in origin, and the tasks it undertook were associated with the rather immediate development of a demonstrable product--either a physical object or an observable behavior that was of general importance for members of the society to learn. Instruction was typically "ground level" in that it was closely involved with the earth, its relatively raw fruits, and the community. Instruction in these schools was often informal as when children gather to receive the daily lesson

from the knee of a mother. However, instruction could become highly structured and associated with ritual, as with the learning of many crafts.

Academic schooling, on the other hand, was not common to all preindustrial communities of man. It was associated with the transmission to a priviledged few of a written or symbolic language. This education served those who were destined to become, by virtue of this transmission of knowledge, the bearers of a culture's sacred trust of written or symbolic tradition. Natural schooling proceeded mostly by students practicing an activity until it was mastered. Academic education was bound to the rigid memorization of words or symbols and the development of literacy or oral skills. Further academic education was not viewed as being necessary for the average citizen before industrial times. The study of words and symbols was considered too ethereal for the average citizen to grasp.

The Tradition of Academic Education

The roots of academic education are founded in man's love for and awe of the symbolic or written expression. Before recorded history one can only assume that academic education existed as the process of transmitting the knowledge of secret or shared written symbols from one element of society to those who aspired to and were allowed to approach that same social status. Early traces of academic education can be found in the specialized training of

shamans and priests of primitive people. By the time of the Egyptians and later the Jews, academic education almost certainly involved the communication of written texts, and the learning of writing itself. With the Egyptians, schooling was almost certainly restricted to the privileged children of the leaders, and was deeply associated with religious mystic rites.

As Western civilization began its crescent sweep out of Africa into Israel, Greece, Rome, and then on to Europe, England and America, the seed of academic education was preserved and continued to be associated with the transmission of written records, often sacred in origin and of growing importance to preserving the continuity of the cultural past. At no time however, did this type of education become universal. Though the men of the Jewish communities of early Israel had fair access to instruction in reading and writing, and in the height of the Greek city-state there existed a remarkable respect for literacy, academic education was the pasttime and endeavor of relatively few. In general, as the state or the religion (if they were separate) of a region grew, the academicians who were valued as interpreters, recorders, and instructors prospered, and so did their craft.

In the Middle Ages of Europe it was Christianity that carried the germ of academic education. Early Christian leaders had to decide if the existing Roman academic schools fit their needs. Ralph Pounds (1968) in

his book The Development of Education in Western Culture notes, "at a time when early Christianity was an underground religion and not in political control, the serious question arose as to whether or not Christians should send their children to school" (p. 91). Many Christians, whose children were in academic schools, decided they would not. Gradually catechetical or "cathedral" schools arose, which according to Pound (1968) offered a "system of training for those who wanted to become members of the church" (p. 91). As Christian education grew the cathedral schools were forced to try to "solve the conflict between the old classical Roman schools built on the Greek pattern and the new emphasis on the other-worldliness of Christianity."

In A.D. 325 Constantine made Christianity the official state religion and the power of the church to organize itself and its schools greatly increased. Pound notes (1968) that from this time the church gradually began "structuring its organization on a pattern similar to that of the empire, becoming very hierarchal in character" (p. 79). A clergy evolved in each city. Bishops and Archbishops were appointed or elected and the Christian schools came to focus on the recitation of theological argument and the training of character through rigorous methods.

The Christian academic education that evolved eliminated many of the freedoms that had characterized the Greek pattern of academic education. It maintained the Roman emphasis on grammar and on clear speaking, but

severely restricted the topics of instruction or discussion. Thus, in A.D. 529, the Emporer Justinian showed his desire to eliminate paganism by ordering the Philosophic School of Athens closed which had maintained a more liberal academic curriculum. The curriculum of the Christian schools continued to remain thoroughly wed to the rigorous study of words for character and clergy training.

The early Christian leaders developed an early dependence on the written word, not because Jesus wrote, but because it was necessary to maintain the internal integrity of Christianity. However, it was not until many years after Christ that the oral records of events critical to that time were put to paper. From the beginning there was much confusion as to what Christianity was, and what it was not. Argument was intense, and it was in an effort to define the doctrines of Christianity that the Council of Nicea and countless other conferences of evolving church leaders were held. The result of these conferences, preserved in writing, became in many cases the basis for church membership. The schools were used to crystalize these beliefs, and the academic nature of the Christian schooling was strengthened. Of this time Pound (1968) relates:

> This was an age where there were very few books, and those few were held in very great reverence. Whenever words were written down, they were held to be authoritative; consequently, education was extremely bookish in nature and the school set out to cultivate the qualities of submissiveness and obedience in the pupils (p. 90).

He continues, by saying that the process of education "was largely one of being certain that the exact subject matter of the text was mastered by the student." This sort of education, based primarily on words and recitation, was not for the common man, but reserved for those who could rise to such monastic discipline. As we shall see, traces of this style of education linger even into today.

Pound, and other authors (Frost and Bailey, 1973) point out that throughout these ages a demand for a broader styled academic schooling, based on the vernacular and less alien to the interests and the needs of the populace at large was voiced. In some cities, such as Brussels in A.D. 1320 vernacular schools arose. But these schools met with fierce opposition from the Church. According to Frost and Bailey (1973) the Church had established the right to license teachers "as a means of controlling education and thereby the minds of men" (p. 161). This was a privilege they guarded jealously.

The Renaissance (A.D. 1300-1500), or "rebirth of learning", had some effect on academic schooling. Students began to rediscover some of the ancient classical literature, courtesy of the contacts of the Western world with the civilizations of Islam. Among these works were remnants of natural philosophy that had been dredged up from Greek and older days and built upon by the Moslems. The schools however, bastions of stoic, disciplined, theologic thought, were not to welcome any frivolous speculation on the material

nature of the universe. Academic schooling remained a place for mind training, the study of the obedience to ecclesiastical doctrine and served very narrow ends. Pound (1968) notes:

> In general, the only kind of education of interest to most scholars of the Renaissance period was that intended for the youth of the upper classes, now generally termed secondary education. The church was interested of course, in preparing scholars and clergy thoroughly for the future leadership of the church, and the secular rulers were interested in having well-trained persons around them in the courts who would be gentlemen as well as scholars. The middle class interest was entirely in breaking into one of these two circles--either the church or the nobility (p. 117).

That which did force entry into the schools was an interest and affection for the classical literature. This introduction was possible in large measure because the written language of the classics was also the adopted language of the church. However, the emphasis in the schools remained on the development of disciplined virtues, not environmental concerns or natural philosophy. In the end, the Renaissance strengthened both the academic word-centered education based on the classical language and the cause for the development of vernacular schools to study those literary gems being uncovered that could not be discussed elsewhere.

The emphasis on the classical language, memorization, strict scholarship, the rigors of mental discipline for moralistic reasons, catechetical instruction, and the favoring of privileged classes was to continue, carried from its ancient mystic roots of bestowed secret knowledge, strengthened by the Church during the Middle Ages, and more

or less maintained through the Renaissance and Reformation, into the Twentieth century.

The Birth of Mass Schooling/The Decline of Natural Schooling

The eighteenth century begins what has been called the age of reason. This was a time of broad social movements, of political unrest, as masses of people were determined to heave off the influences of tradition--both of Church and state. It was a time of increasing humanism, a la Rousseau (1712-1778) and Locke (1632-1704), of emergent capitalism, increasing scientific endeavor, industrial expansion, and increased frustration with traditional schools. The cry, "liberty, equality, fraternity", of the social reformist, could have been dealt with in a number of ways by educational reformers. Unfortunately the way that evolved only brought an adapted form of traditional academic education to the masses. Though some attempts were made to integrate the practical concerns of the natural schools with the words and rhetoric of academic concern (an attempt that I will explore in Chapters III and IV), the schooling that was offered to the masses was merely a revised version of the traditional academic schooling that had been the schooling of the elite. This would not necessarily be a bad thing, for (as I noted) both forms of education were useful to society, except that simultaneously with the bringing of academic schooling to the masses a most dangerous occurence began, and that was the

gradual erosion of natural schools. This erosion began as village culture was slowly washed away by the tremendous forces of change that were being introduced into societies at this time in the West. Natural schools were, after all, a product of natural communities--communities that had evolved within relatively small natural geographic boundaries, and whose members were intimately associated with ground level interactions. The school's function had consisted largely of transmitting knowledge that was useful mainly within these village settings. The integrity of the overlying society, comprised of numerous village communities, was partially maintained by the similarity of the ground level interactions taught in the various natural schools. As these ground level interactions disappeared the natural schools that existed to teach these basic environmental/community interactions also disappeared. Only the academic schools could survive the transition to an industrial economy as the study of words transcended the cultural boundaries more efficiently than the study of ground and community skills. Academic education could easily have rescued many of the fallen skills of community life, preserved them and taught them to their students, but this happened only in limited degree. The schools which the masses of students entered were not concerned with the affairs of practical living, they were the rigid stoical institutions they had always been. The increasing numbers of youth were placed in schools that did not consider ground

level interactions important. The schools effectively removed the youth from the chance of meaningful interaction or work in the natural environment, and thereby planted seeds of mass cultural alienation.

During these years the schools in the academic tradition expanded the boundaries of their operation, though not their character. As Ivan Illich (1973) reminds us, "We often forget that education acquired its present sense only recently. It was unknown before the Reformation, except as that part of early upbringing which is common to piglets, ducks and man" (p. 19). While education in the broad sense of the word (according to Smith, Stanley & Shores, 1957), "the entire social process by which individuals acquire the ways, beliefs and standards of society" (p. 1), has always taken place in the cultures of man, this modern form of specialized education, accomplished via mass schooling in the academic tradition is a relatively new phenomena. The changing strengths of the two educational types is represented in Figure 3.

In a sense mass schooling in the West arose because it had to as agencies of natural schooling: family, church and community were in a rapid state of decay, and something had to appear to replace the erosion. Public schools appeared for a variety of reasons: there had to be a place to deposit the children as the parents, first one and in time both of them began to work away from home; there was need to occupy youths time, to "keep them off the streets"

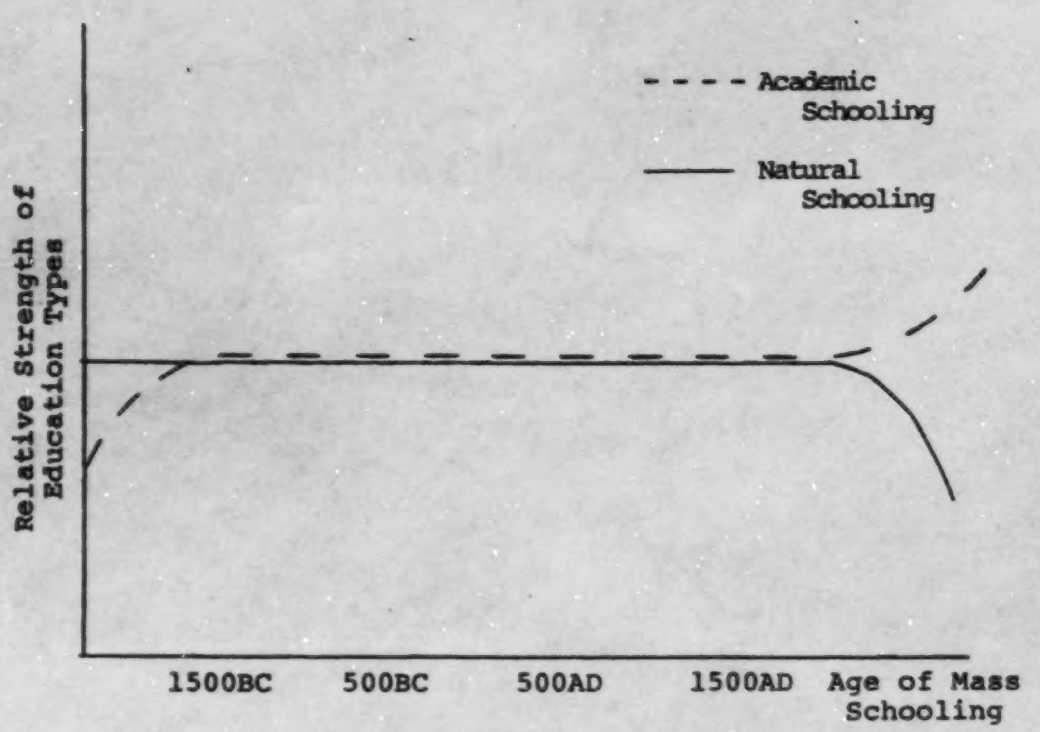


Figure 3. Historical strength of schooling types.

so to speak; there was need to teach children the social amenities and ethical principles that might not be adequately taught in the home, especially as the child must now be trained to function in a society instead of just a community; there was need to instruct youth in the skills that would prepare them for jobs in expanding industry; and there was need to attempt to explain to youth what all this change was about and how they were a part of it. As village culture continued to erode, more and more of the burden of

enculturation fell upon the educators, who were probably not united in what they were trying to do. For each function that schooling might conceivably tend to, a set of advocates arose (Gumberg & Spring, 1974). The politician saw in the schools a means of obtaining social ends, the religionist desired moral ends, the industrialist desired practical ends, and many community members simply desired the school to perform custodial ends. But whatever ends schooling might be called on to serve, its functioning was essential to the maintenance of the evolving new way of life. Mass schooling arose out of the necessity of the type of growth Western society was engaged in. As Gumbert and Spring (1974) observe in their analysis of American education in the twentieth century, early American leaders of thought and industry were quick to recognize the potential benefits of mass education. They state:

> Education theory and practice did not remain free from the influence of government or industry. Indeed, universal schooling developed as an important agency in the movement to incorporate everybody into the industrial state. The politicalization of education in its modern form was advocated in the 18th century in France by such revolutionary thinkers as Cordorcet, and was continued in the United States. Jefferson, Franklin and Mann saw the schools as instruments for achieving desired social ends (p. 73).

Modern educators increasingly recognize the role that schooling must perform in the reorientation of youth to a changing environment. It is not that adults do not also need reorientation, but rather that their time is being thoroughly engaged in the process of economic survival and

growth. It is also more critical to orient the upcoming youth if the culture is to survive in the changing of generations. The authors (Smith, Stanley, & Shores, 1975) of a classic curriculum text note:

> When alternative elements appear in a culture, they tend to disturb the cultural pattern.... As alternatives increase relative to the universals, social change is increased; and the need for reintegration becomes more and more imperative if the culture is not to disintegrate (p. 13).

These writers have not missed identifying the inaugurators of this change. They write:

> It is perhaps not too much to say that every significant curriculum problem of today is related in one way or another in the general problem of cultural reintegration created by the increasing advancement of science and technology. These forces are uprooting the people of America (p. 25).

The task of the noble educator in the face of this modern challenge is to formulate a picture of society that is realistic, cohesive, and useful to the student in interpreting and affecting change in those processes that occur around him. In addition the educator needs to transmit those skills to the youth that will enable them to choose and adapt a life style that is comfortable. Failure to fulfill these goals lead to the formation of a picture of society that becomes blurred. In such a setting Smith, Stanley and Shores (1957) note, "... individuals find themselves unable to carry on normal activities in a rational way" (p. 19). I question both the accuracy of the world view, and the adaptive power of what is taught as content in the typical high school and college science programs of today.

As Smith, Stanley, and Shores (1957) note Western man has undergone, "the change from the intimate face to face relationships of the neighborhood and small community to the impersonal, abstract, relationship of the urban community and the national and global network of interdependence" (p. 70). Science and technology have played a major role in the transition. These educators continue:

> Science and technology while breeding interdependence on a wide scale, have at the same time divorced the individual from the direct perception of the consequence of his activities ... with the loss of the controling influence of the direct perception of the effects of one's own actions have gone also many of the common rules of conduct that grew up in response to the intimate association of old fashioned community (p. 70).

Science educators should begin to address the question of how to help the individual regain, through the practice of science, the sense of having control of one's life.

The Evolving Style of Mass Education: The Reaction and the Counterreaction

In an age mesmerized by the awe of mechanization, it is not surprising that a mechanistic model for schooling would also evolve. As youth were severed from work performed with the family and community, and the need for schools increased, educators became increasingly concerned with finding an efficient method of schooling. It is largely the method proposed by the Moravian teacher-theologian John Amos Comenius (1592-1670) that won ascendancy in mass schooling. Mumford (1970) quotes Comenius as writing;

"It will be as pleasant to see education carried out on my plan as to look at an automatic machine, and the process will be as free from failure as these mechanical contrivances when skillfully made...." (p. 103).

As Ivan Illich (1973), a modern critic of industrialized schooling, notes, Comenius is "rightly considered one of the founders of the modern school. He is the first to propose seven or twelve grades of compulsary learning" (p. 19). Comenius's prophetic sight envisioned that education would be arranged step wise as in a ladder. The student should begin climbing this ladder as soon as possible and in ordered movements continue the climb upward as far as he is able. This sequential model of schooling has in our day developed into a continuous stream of grades or levels that stretch in ordered array from childhood to maturity, through which a youth must pass by conforming his academic interests to the task that is presented him. Comenius, like others in his time, was fascinated by the laws of mechanical order and hoped that youth could be made to work with such precision and harmony. His love of order in education can be understood in terms of the academic theologic tradition which was of obedient subservience to revered authority. Education was for moral ends and character building. However, though Comenius loved order, he was also a humanist. According to Frost and Bailley (1973) he was an advocate of universal democratic education, and believed that compulsion and force in teaching were admissions of failure and that

each child could be motivated to learn if his interests could be appealed to. Though our present style of academic education is orderly, I believe it is doubtful that it can be said that it considers the interests of the learner, though some progress has been made in this concern.

At least two aspects of regimented instruction had increasing appeal to educators. One was the efficiency of the system, which allowed educators to handle large numbers of students with minimum planning and management. The other was rigid obedience to the teacher; having children perform with clockwork uniformity was considered to help instill in the students the social virtues of punctuality, discipline, orderliness, courtesy, hardwork, cooperation and a working harmony. The school was essentially a workshop where teachers tried to construct a better human machine. The religionist could view these practices as character refining, and the industrialist as building good worker traits. Social reformers could view them as helping to develop good qualities of citizenship, and parents could be appeased that their children were being taught skills that would help them to prosper in the new way of life. Thus the first model of American education could be popularly characterized as the "reading, writing, arithmetic and hickory switch system."

Of course the school as we know it today did not immediately spring forth from the earth preformed, but gradually evolved one step at a time, from the elementary school up. Gumbert and Spring (1974) note:

> The belief in the power of education worked its way up the educational system. From approximately 1840 to 1918 attention was centered on the elementary schools. With the virtual achievement of universal elementary education by 1918, educationists turned their attention to the secondary schools and attributed great socializing powers to them. As large numbers of youngsters continued to the universities, beginning roughly in 1945, the unbounded faith in the power of education to cure all social ills was extended to include them. Thus, over a period of two centuries the whole educational system was fused into a national instrument with broad social, political, and economic objectives (p. 74).

Recently, the assembly line style of education has gradually become tagged the "traditional" approach to education. This is a bit of a misnomer really because this educational format was in no way traditional for the masses of people who existed in village cultures of the past. This education was only traditional to the academic style of education that had been received by the favored few of the past.

It is significant to consider the battle of the larger social, political and economic interests that were being fought throughout America as the American educational system was developing. From its inception as an independent nation, American leaders were somewhat torn as to what the attitude of the government should be toward private enterprise and industrialism. This attitude would also affect the nature of schooling. The initial polemic between government and industry was expressed in the dialogue between Jefferson who favored an agrarian economy and Hamilton who favored an industrial one.

At the turn of the twentieth century, there arose a new dynamic to the spirit of education that was much more Jeffersonian, and against the industrial mechanization of education. It took its banner under the name of "child-centered pedagogy" and "progressivism," and began to challenge the "traditionalist" views of education. Its hero was John Dewey, of whom Lawrence Cremin (1976) said, "the irony is that an age that has all but forgotten Dewey is still governed by his analytical concepts" (p. 8). In 1938 Dewey expressed the battle thusly:

> The history of educational philosophy is marked by opposition between the idea that education is development from within and that it is formation from without, that it is based upon natural endowments and that education is a process of overcoming natural inclination and substituting in its place habits acquired under external pressure.
>
> At present, the opposition, so far as practical affairs of the school are concerned, tends to take the form of the contrast between traditional and progressive education (p. 17).

Progressivism was a reaction against the mechanical world picture that was fast engulfing the planet and its children. Though its early manifestation, expressed in 1899 by Dewey in '<u>The School and Society</u>', was politically neutral focusing only on making "the child become the sun around which the appliances of education revolve," its post depression character was increasingly political. Gumbert and Spring (1974) observe, "The Depression switched attention of some educators who had been interested in it in the 1920's from child-centered education to social reconstructionism" (p. 26).

The Depression served as fertile ground for a reactionary attack on the growing forces of industrialization of both business and school. In 1936 in his Annual Message to Congress, Roosevelt claimed that "the enemy" was "the minority business and industry ... the unscrupulous moneychangers ... (who stole) the livery of great national constitutional ideals to serve discredited special interest." This should be proof enough of the existence of a growing industrialism which has strength enough to arouse the anger of an American President. In 1948 at an "antibusiness" speech at Dexter, Iowa a few weeks before his election, Truman asserted, "The Wall Street reactionaries are not satisfied with being rich ... they are gluttons of privilege ... Cold men ... cunning men ... They want a return of the Wall Street dictatorship." By mid 1980, American politics could be viewed as a battle waged by a numerically diverse, angry, but ununited David of assorted citizens and politicians, who engaged in saber rattling against a large and amorphous Goliath of industry. However, as Goliath was shaping the society that David was living in and had in part grown accustomed to, the question becomes how badly does David want change, and how effectively can he withstand the social transition that would inevitably be associated with a slow down of industrial expansion.

In the 1930's, the progressives under the leadership of Dewey, Kilpatrick, Counts, Childs and others at Teachers College, mounted their social reconstructionist assault on

the "traditionalist" values of rugged individualism and capitalistic autonomy. They were aware that a young America--barely a century old--was fast losing its nascent sense of community to the pinning wheels of industrialization. This new uprising gave hope to others. In 1934, the Commission on the Social Studies in the Schools (appointed by the American Historical Association) in its published recommendations on the instruction in schools joyously began proclaiming a reversal. They perceived that the age of individualism and laissez faire in economy and government was closing and that a new age of collectivism was emerging. They said, "If education continues to emphasize the philosophy of individualism in economy it will increase the accompanying social tensions." According to Gumbert and Spring (1974):

> the social reconstructionist advocated switching the focus of the schools from academic subjects to social and community needs and problems. Following Dewey, they held that the school had a role to play in reforming and humanizing industrial civilization (p. 27).

While the political and educational progressives attacked, a powerful counter-attack was launched. In 1934 the Liberty league was founded. As Gumbert and Spring (1974) note, this organization founded on moneys primarily from Dupont and General Motors set up a self proclaimed "educational organization" to counter the "communistic elements (that) lead people to believe that all businessmen are crooks" (p. 31). The era of increased name calling and fear arousal had begun. Gumbert and Spring (1974) report on the educational traditionalist counter-attack:

> In the 1950's, both the child-centered and the society-centered approaches of progressive education came under heavy criticism. Critics such as Arthur Bestor and Albert Lynd claimed that progressive education over psychologized instruction, that it was too indulgent with the pupils, that it was sentimental, and that it did not foster intellectual excellence. Throughout the 1950's and 1960's, the assertion that 'the gifted students are neglected' was widely heard. Critics also wanted a return to fundamentals to a subject centered education (p. 39).

In the end, the traditionalist won, due to the influence of the American fear of communism. In 1957, Russia, via its launching of Sputnik, did much more for advancing us further into the mathematical-mechanical approach to learning than the traditionalist had ever been able to. The fear of Russian assault fed the engines of the mechanization and the so-called "sentimental" education advanced by progressives was successfully squelched for a while. Today as Cremin (1976) has noted in his book Public Education, the banner once held by the old progressives can again be recognized in the summons of "new wave" educators such as A. S. Neil, John Holt, Paul Goodman, Ivan Illich and others.

The Weakness of the Social Reconstructionist Stance

John Dewey and the Progressive Education Association (PEA), founded by Stanwood Cobb, were probably the most powerful of the reformists, but ultimately their cause ebbed, albeit their flag has been raised by others. There was a basic weakness in their approach. Thinkers who wish to use the schools as an agent of reconstruction overlook

the comparative weakness of a school to accomplish this goal. Within an increasingly complex and glaring society, the school represents an increasingly diminished stimulus, which must vie with other agencies for the attention of the youth. Cremin (1976) recognized that the problem is in "Dewian polarity of all life being broadly educative and overwhelmingly powerful ... (while) the school (is) being intentionally educative but not very powerful at all" (p. 22). He states, "In a modern industrial society with the multiplicity of political and educative agencies, the school could never be the main determinent of political, intellectual and moral change" (p. 6). Willis Harmon (1969) has envisioned in this way, "A movement within the school system which is not aligned with the general drift of the larger society, for instance, is unlikely to persist" (p. 45).

In effect, in the mid to late twentieth century, there is no institution that remains, whether family, church, community, state or school, that can resist the technological push into the future. The fear is that no one, no man, or group of balanced ethics is controlling the direction of this drift. Government may try to intervene to regulate industrial expansion, environmental concerns, and social problems, but society continues to move toward cancerous growth. This is largely because the decisions that affect the structure of Western society are no longer made by a small group of individuals that are easy to identify and thus to control. The seat of power has shifted in our times and

no attempt to regulate it at its previous position will work. Just as kings and clergy no longer maintain control over the structure and direction of modern society; neither does the landed aristocracy and industrial giants who used to exercise social sway into the twentieth century. Rather the pattern that the society will form is laid by a multitudinous collection of small group decision makers.

In 1971, Galbraith identified this new capital of power in the state of industry. He termed this new seat of control in industry the "technostructure." He writes, the technostructure consists of "all who bring specialized knowledge, talent, or experience to group decision making" (p. 84). He continues, "This, not the management is the guiding intellegence--the brain--of the enterprise." The technostructure consists of an incredibly diverse assemblage of peoples, whose expertise covers most every area of concern in post-industrial life, and it is their collective endeavor that turns the wheels of industry. This group of specialists, though potentially a potent healing force to the body of mankind, is nevertheless marred by several severe flaws.

As Galbraith relates, one of these flaws is that the motivating concern of the technostructure is not the nature of the society it is building, but its own self preservation. Its members seek to maintain their jobs; its products are those that sell, not those that seek first to enhance the nobility of man. There are other ills that stem from this general malady; the technostructure demands loyalty

to its goals from its members and those that work for and depend on it, but often at a cost of narrowed thinking. Galbraith (1971) notes, "the executive cannot afford to have it thought that his commitment to the goals of the corporation is less than complete, or that he is at all indifferent to his opportunity to shape these goals" (p. 145). Further, as noted before, the technostructure is dependent on a controlled market for survival. People must buy for expansion to continue. Therefore a powerful industry of persuasion--the advertising industry--has developed. Further, people must not think too deeply about what the future might bring if we continue on the same course of industrial development, for as Jules Henry (1965) put it, "If we were all logicians the economy could not survive, and herein lies a terrifying paradox, for in order to exist economically as we are, we must try by might and main to remain stupid" (p. 48).

From this critique we can catch a glimpse of some of the forces that shape our industrialized society. We have exposed the tendency of industry to rise like the phoenix who stubbornly refuses to consider the earth. Further any discussion that can be safely entertained by the members of the technostructure seems to be confined to the consideration of only skyward flight. Our society therefore, formed in large part by early industrialists and modern day technocrats (members of the technostructure), continues to move further away from all that is psychically familiar to the ancient race of man.

Now we must ask ourselves; to what degree are the schools content with riding this wave of industrialization, and ignoring its negative affects both in society and in the soul of modern man. The early progressives and naturalists fought out against the industrialization, alienation and mechanization of man. They did not win their battle, largely because they were not equipped for the strength and nature of the foe which had become ubiquitous. Industry is not in itself bad, however the industrialization of humans is atrocious. Yet this industrialization, this growing feeling that man is a stranger in his own world, was being accomplished by average but trained men, by technocrats of most every profession; and the only weapon that would be effective against these men would be to touch their hearts with insight, reason and patience to combat any tendency toward self interest, impetuousness and short sightedness. The battle that must be waged is a spiritual battle, a battle of identifying when the preeminent values of humane living are being compromised. It is a battle that requires a religious movement not just an educational or political movement. Thus education was forced to adapt to the evolution of society fueled by industry and science. But the issue of Dewey still remains: Are we shaping students to fit into a social mold that is preset, or are we giving them the freedom and skills to help them recast the mold if they like? Is education to be from within or without? If educators are willing to drift along and adapt to whatever serves the industrial

needs, then I conclude their interests lies with the rising phoenix, and they gamble on a bird that may not have a pilot. If, on the other hand, educators allow the individual and his community needs more sovereignty, then their interests lie earthward, and hopefully they can learn from their flight. Either way will involve continued transition for the society of man. I do not think we have as yet the strength of religious conviction to arrest our star bound flight. I perceive at least two indicators that educators are wed to this upward flight. One is the growing dependence of many research institutions of higher learning (schools and universities) on grants which come from large industrial and government concerns. John Steinhart (1972) observes in an article on "Institutions and the Generation of Purpose":

> We have a closed system and it matters little to the Federal Government or the Ford Foundation what fundamental goals and purposes the grant applicant sees for society. The results at best are a prescription for those people to solve their problems (p. 17).

If as Steinhart indicates, 20% of our economy is dependent on grants, and grants are awarded primarily toward the investigation of problems encountered in industry or the application of costly technology, which is only affordable to industry or government, to industrial concerns; then we have reason to fear that a considerable selection process is in effect which forces us further into industrialization and narrows the options of alternative social forms. If we are forming our national social character via the allocation of

funds that determine which character traits we will favor and which we will not, then it appears we are favoring the impressive high yield variety in which all character genes selected must contribute to the formation of an increasingly industrial/technological society. The price of this financial selection process is decreased variability in national social character and thus increased susceptibility to disease. Thus we move forward, but into what?

The other evidence of educators' commitment skyward is in the continued lack of ground level instruction in the schools of higher learning which could be used by the students to help fashion their world. This is especially true of the science instruction in these schools. The technical instruction afforded to college students can rarely be utilized by them to create real change in their environment. It seems to me that though technical instruction may be offered in such practical things as auto mechanics or air conditioning repair; the skills, and opportunities to create these structures that could bring forth a truly alternative society to post-industrial man are seldom seriously considered or offered in a meaningful way to the science students. The science offered is megascience and the technology mega-technology. Most students, perhaps 90% that become frustrated with the presentation of science, are thus rendered pawns to the technological society that is constructed by the 10% of students that can persist in the mind bending pursuit of academic science as it is presented in the

schools. This leads us to the concerns of Chapter III: The evolution o. the science curricula in the West.

CHAPTER III

SCHOOLS AND THE EMERGING SCIENCE CURRICULUM

Early Science and the Schools

In one sense there is one movement that describes the drifting focus of education since the Renaissance, and that is the drift away from a history of religious emphasis in schooling. The rise of science was as much a part of the Reformation as was Martin Luther's nailing of his set of 95 theses to the door of the church in Wittenberg in 1517. Both the philosophers of science and the philosophers of religion were concerned with the throwing off of the yoke of tradition, and allowing man some room to breathe and think. The leaders of both movements were often profoundly religious men--spiritual seekers of the path of truth. Most did not deny God, but rather the box to which religious tradition had confined him. In retrospect, the Reformation was a bittersweet victory. It produced increasing waves of academic and religious freedom, but it also began a fractioning of the church that has not stopped since, and released an unbridled materialistic philosophy into the world.

Many people did not see the points of conflict between the teaching of science and the traditionally

religious education. Comenius, a theologian, certainly was not plagued by this concern, and as Underhill notes, was among the first to urge the teaching of natural sciences in the schools. Underhill (1941) writes, "Comenius has frequently been referred to as the first to introduce the study of nature into the schools. The 'Orbis Pictus' is the most famous of these early attempts at the study of 'things not words'...." (p. 14). However, science was generally not taught in the academic schools, and this was largely a matter of the conceived purpose of education. Descartes had split the world into two neat parcels: mind and matter, and the schools, still under theologic control, had largely opted to concern themselves only with the affairs of the mind. Pound (1968) writes:

> Thus, Descartes left mind, or the spiritual part of the world to theology (or philosophy), but assigned to science complete supremacy in the realm of matter. This led, of course, to an extreme form of dualism which although it had been present to some extent in both Platonic idealism and Aristotelian realism, during this period became a concept of the existence of two widely separate and different substances (p. 148).

This separation, according to Pound, "would cause education not to be concerned about the scientific and material aspects of man's existence, or at least to minimize these as compared to the mental and spiritual." Academic education proceeded by the rigorous methods we have mentioned before, and the mind or reasoning side of man was the continued target of education. Therefore, to quote from Pound (1968):

> The important stress in education at this time (1500-1700), and continuing on through the enlightenment

> period, was an emphasis upon the rationalistic aspect both in its purposes and its content. Rationalism fitted with the old humanistic tradition and, although mathematics and to some extent modern languages were taught, the continued emphasis upon classic literature was deemed to be more important in developing reason than science which depended on sense experience (p. 149).

The emphases on the classical language instead of the vernacular, and the study of some mathematics were valued as disciplines which could cause the mind to become ordered. These subjects were not studied for their utility to common problems.

The Enlightenment Years

The first emergence of science in the schools was to occur during the Enlightenment years, in the primary schools. In general these schools were more responsive to the winds of change, largely because they were less formal and closer in spirit to the natural schools. The sciences were to enter through a set of didactic writers who were writing material, usually stories, for use in the instruction of children. Their books and magazines often contained short features on the novelties found in scientific discoveries, and about the wonders of modern technology. Underhill (1941) explains how these teachings were used:

> These books and magazines (of the didactics) indicate that the various phases of scientific knowledge were playing a definite part in the thinking of the class of people who educated their children at home, and that such information was considered as an accepted part of the liberal education of an English gentleman (p. 15).

This beginning of the instruction of sciences in the schools does not in any sense represent a major thrust toward the planned instruction of sciences. Sciences entered as a novelty, a curiosity. The science that had sprung forth in the writings of the didactics was only a popularized caricature of science. It was designed to entertain. Underhill (1941) explains:

> The science itself seems to play no part in this method of inculcating desirable character traits (the concern of primary educators in that day), but seems rather designed to furnish amusement or entertainment whereby the instructional function is to be made more interesting and perhaps somewhat less painful (p. 27).

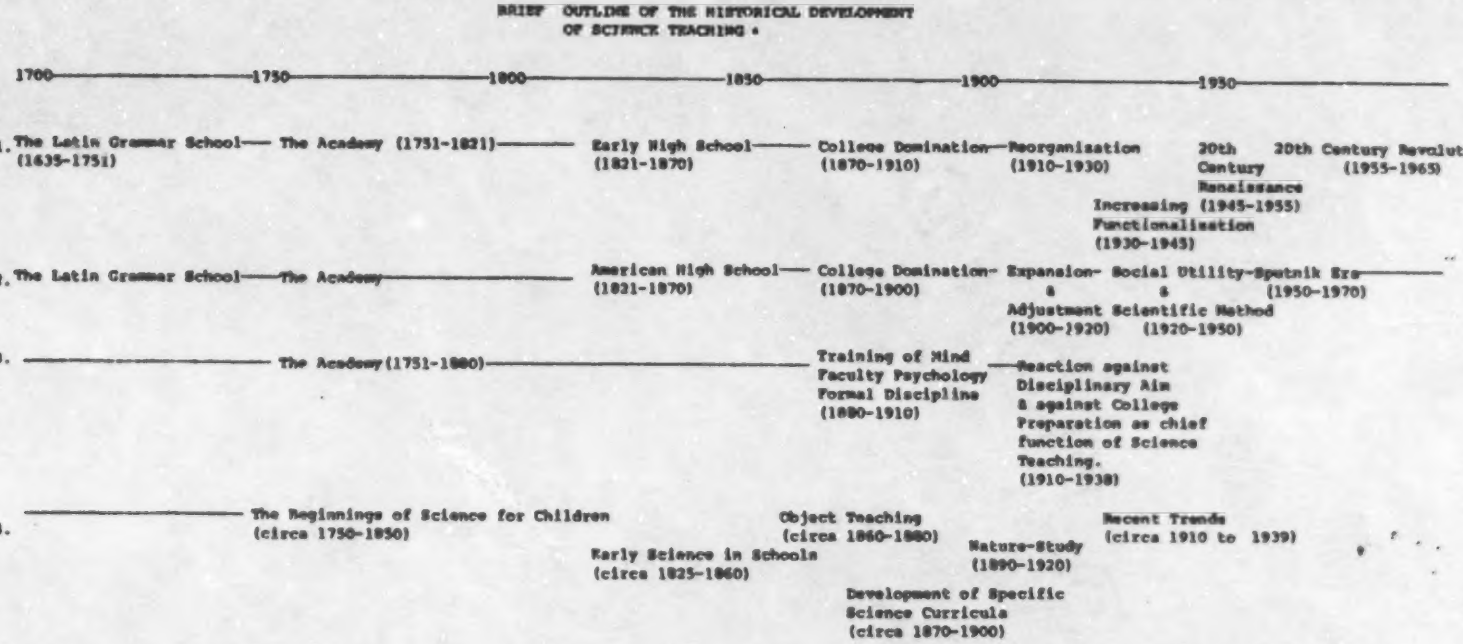
The didactic literature is largely religious in tone. Its authors, exercising a new right of religious expression, would use the opportunity to expound philosophical commentary on the nature of life. Their discussions of nature were often used for a point of departure for more abstract muses. Yet, as the pendulum of public opinion began shifting further toward a distrust in religious writing, as church denominations multiplied and people became more divided in their religious views, the didactics were forced to become more moderate in their writing. Underhill (1941) notes that, "while the explicit statements as to purpose (of their writings) seem to emphasize moral implications, the selection and arrangement of the materials themselves give more emphasis to the former function, factual knowledge" (p. 49).

It is these more moderate writings that became the first school readers, and had the effect of shifting

elementary education more toward academic than natural instruction. Underhill (1941) notes that the emphasis was shifting "from a study of things and phenomena to a study about things and phenomena" (p. 48). When the sciences finally entered the schools, they entered within the narrow tradition of a word-centered education for the few privileged youth whose parents could afford to send them to school to get an education of letters.

The Schools and Rising Science in America

We will now transplant the focus of our analysis to American shores. In Figure 4 I have prepared a presentation of the historical development of science education in America from information given by several authors. I have included it so that some of the terms used to describe this evolution may become familiar to the reader. The battle between the progressives and the traditionalists can be clearly seen in the labels applied to the years between about 1850 to 1950. Such terms as: faculty psychology, the Sputnik era, and the twentieth century revolution refer to advances by the traditionalists with their emphasis on academic concepts and a rigorous curriculum; while terms such as: functionalization, social utility, and nature study represents attempts to personalize curriculum, make it more directly relate to the environment of man, and present it in a way that gives the student a skill. I will follow a simplified syncretic outline of the same major trends discussed by these authors.


BRIEF OUTLINE OF THE HISTORICAL DEVELOPMENT OF SCIENCE TEACHING *
1700
1750
1800
1850
1900
1950
1. The Latin Grammar School (1635-1751)
The Academy (1751-1821)
Early High School (1821-1870)
College Domination (1870-1910)
Reorganisation (1910-1930)
Increasing Functionalisation (1930-1945)
20th Century Renaissance (1945-1955)
20th Century Revolution (1955-1965)
2. The Latin Grammar School
The Academy
American High School (1821-1870)
College Domination (1870-1900)
Expansion & Adjustment (1900-1920)
Social Utility & Scientific Method (1920-1950)
Sputnik Era (1950-1970)
3. The Academy (1751-1880)
Training of Mind Faculty Psychology Formal Discipline (1880-1910)
Reaction against Disciplinary Aim & against College Preparation as chief function of Science Teaching. (1910-1938)
4. The Beginnings of Science for Children (circa 1750-1850)
Early Science in Schools (circa 1825-1860)
Object Teaching (circa 1860-1880)
Development of Specific Science Curricula (circa 1870-1900)
Nature-Study (1890-1920)
Recent Trends (circa 1910 to 1939)

* This outline is adapted from the historical presentations on science teaching from the following authors:
1. Lacey (1966)
2. Fowler (1979)
3. Progressive Education Association (1937)
4. Underhill (1941)

Numbers in front of the author's name corresponds to the author's outline presented by number above.

Figure 4. Brief outline of the historical development of science teaching.

My outline is presented in Figure 5. I do not feel I have the historic perspective to make classifications beyond 1970.

The Latin Grammar School

The colonizing of America brought the traditional secondary Latin-Grammar school of Europe to America. The first of these schools was established in Boston in 1635. The Latin-Grammar school was an academic school in the purest tradition. Its function was to prepare a select group of privileged youth for college and a subsequent profession related to church or state. As the name of the school implies the emphasis was on studies in the classical language, and for the purposes of mind and moral training. Seymour Fowler (1978) in his historical analysis of the development of science education reminds us that, "In his curriculum the student (of that day) expected humanistic rather than naturalistic studies, classical rather than scientific studies." As has been true of academic education from its inception, with the concern not being on utilitarian outcomes--education was for the purpose of gaining access to social status by virtue of some uncommon verbal mastery. Fowler continues, "preparation in the Latin-Grammar schools in the new world did not advance one's education to as great a degree as it did to promote social mobility both in one's economic class and in one's social status" (p. 82). However, with the shifting winds of social structure, the

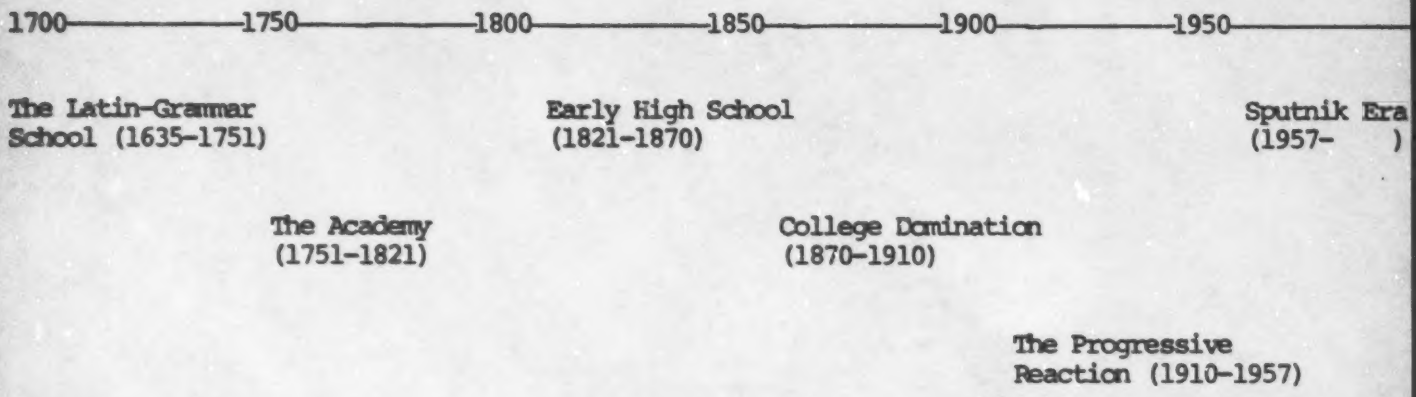


Figure 5. Adapted outline of the development of science education in the secondary schools.

collapse of the traditional ways of life, the voice of political and social upheaval and unrest, the questioning of students and their financers as to the utility of this sort of education, the Latin-Grammar school had not long to live. Pound (1968) notes, "Some of the rigidly traditional grammar schools had become quite remote from the interests of the students. In some cases, this resulted in considerable rioting among the students or a loss of enrollment" (p. 183).

The American Academies

To meet the challenge of the changing times, Benjamin Franklin (1706-1790) proposed the establishment of an academy to replace the Latin-Grammar school. Riding the height of popular sentiment, he was able to propose a more utilitarian secondary school. In 1749 he published a brochure entitled: "Proposal Relating to the Education of Youth in Pennsylvania." In it he urged that youth be taught those things "that are most useful and ornamental, regard being had to the several professions." This proposal contained two radical innovations for the secondary schools of the time: (1) to make the language of the school the vernacular, and (2) to focus attention on that instruction which would be utilitarian. The first of these attempts succeeded. The second intervention also succeeded, but in a narrowed sense.

It is important to understand the nature of these changes. In the light of political unrest, which would later culminate in two national revolutions, and the gathering momentum for social change, it became possible for Franklin and other popular leaders to effect a change in the language of instruction. Latin and Greek were not to be abandoned however, Harvard and other universities continued to require a demonstrated proficiency in these languages to gain entry into the school. By doing so, they exercised their effect on the curricula of secondary schools. Franklin's school should not be conceived as a popular school--a school for the masses. This innovation would come later. The academy was a private institution, still for the upper classes of society, which continued to train youth for the colleges, as did the Latin schools. The innovation toward utility in instruction was aimed at the preparation of some youth for the practical skills that would be needed in the pursuit of industrial concerns. Graduates of the school would become leaders in industry. Franklin's academy should not be conceived as democratic training in ground level interactions. The curriculum remained essentially the same as that of the ancient Latin schools, which in their passage through the Renaissance had acquired some study of non-religious literature and mathematics. The new curriculum consisted of reading, history, grammar, oratory, composition, literature and logic. In some of the academies Fowler (1978) notes, that natural philosophy and chemistry appear for the first

time. But, despite Franklin's mention of gardens, experimentation and exercise, the spirit of instruction remained essentially traditionally academic. The Progressive Educational Association (PEA) (1937) notes, that in this time:

> Instruction was organized to facilitate the presentation of factual material with little regard for developing relationships. Indeed, some of the early texts were written in the form of catechisms. The predominant method of teaching was the assigning of material to be learned and the hearing of recitations on the assigned material. All of this would appear to indicate a value placed upon the ability to describe phenomena as an end in itself (p. 6).

Lacey (1966) mentions that the academies' methods of instruction stressed lecture, memorization, and assigned recitation. During these times education continued to be for a small privileged group, though increasing efforts are seen in support of public education.

The English High School

The forces which would push us into the fullfillment of Comenius's dream of democratic popular education erupted in the 1820's. There were a number of significant vectors to this move: among them the increasing rise of a labor class, the growth of urbanism, the influence of Jacksonian democracy, and the practical consideration of what to do with large groups of youth that were developing in urban centers, and had nothing to do with their time. That form of schooling which would rise to the surface in these days was the English Classical School, formed in Boston by a

group of Bostonian businessmen in 1821. In 1824 the secretary of the Boston school committee proposed the school be renamed "The English High School," in part to bury its association with the older schools, and to indicate a shift away from the traditional education. The purpose of the school was to prepare youth for the jobs developing in the industrial and business communities. As Fowler (1978) notes, "the proponents of the high school did not want to develop an institution that would replace the academy.... The high schools' originators hoped to prepare a program for young men who would not go on to college and who would enter all phases of commercial life." This school was financed through public funds and was open to all boys at the age of 12. The popularity of these schools soared, and prototypes began appearing throughout the United States. In 1827 Massachusetts became the first state to pass a law requiring towns to establish a boys and a girls high school. Pound (1968) states that by 1900 there appeared over 6,000 public high schools (the word "English" had been dropped), and these enrolled over 80 per cent of all secondary students. The high school, originally conceived as a non-college preparatory institution, soon became a four year co-educational institution which did prepare students for college as well as for business and commerce. By 1900 the high school had clearly assumed a role as a college preparatory institution. Pound (1968) writes:

> ... the high schools contained several types of parallel courses--the classical courses for college preparation, English--historical courses, scientific courses, business courses, technical courses, and home economic courses. All of these courses were for certain distinct practical purposes and in a sense were in conflict with the religious--humanistic aims which had dominated secondary education in Europe and the Latin grammar schools and the academies in the United States.
>
> These changes in the secondary schools reflected the changes arising in society at that same time. American society was becoming much more secular. Nationalism, technology, the development of science and industry, and the expansion of the capitalistic system were taking more and more of our energies as opposed to the prior emphasis on the religious or other-worldly traditions. Along with these secular forces was the development of the democratic trends, which implies that all American youth ought to have an opportunity to succeed (p. 205).

As part of the increased secularization, and because of an increased awareness on the part of the masses of the growing effect of technology on their lives, the sciences were included in the curriculum of these schools. However, this was not participatory science as much as it was passive, academic science. The shift away from religious-moral training continued. By the mid 1900's the changing society no longer required church leaders and statesmen, vestiges of the older world, as much as it did workers and industrialists. However, neither did this changing society seem to require maintaining the older style village communities, or their primary producers. Brother industry's magic had been worked, and its effect was beginning to be felt in the school curricula. The courses that were offered were not of ground level skills--skills of community living and association with the land, but skills of consumption, of accepting the

social forces of change, and of mass production. The first formers of these schools were businessmen not humanists.

The Era of College Domination

If enrollment is any indication, the high schools were winning acceptance, in the changing social scene, and educators were enjoying relative freedom in the preparation of lessons. However, in the late 1800's a subtle restraining hand slowly fashioned its grip over the teachers' freedom to prepare the lessons of science instruction. In 1872 Harvard began accepting science courses from a student's high school background as credit toward his enrollment. This is the sort of bitter sweet victory that science educators should be wary of. Fowler (1978) observes, "by so doing, Harvard could dictate what were acceptable not only as high school science courses but also what the content might be in the courses." He continues:

> During this period from 1870-1900 high school science courses became minature college science courses. College professors prepared the courses of study used in high school sciences and they wrote the text books. The science courses had little or no practical value but instead served to prepare the student for more of the same in college (p. 86).

In 1892, the Committee of Ten on Secondary School Studies of the National Educational Association (NEA) emphasized that no differentiation in courses should be made between students who intend to go to college and those who expect to enter vocational life. The effect of this ruling

was to rigidify secondary school instruction in favor of academic college preparation.

During this period the influence of the sciences was to grow, in order to meet the demands of the colleges. Fowler (1978) observes that it is shortly after the year 1900 that the familiar sequence of "year 1, physical geography; year 2, biology; year 3, physics; year 4, chemistry appears." This development led to the practice of hiring teachers just to teach the sciences. However, I cannot fully discuss the reason for the success of the sciences in the high school and college curricula without a brief digression from my proposed outline to discuss a mystical substitution.

The Mystical Substitution

In the early 1900's a mystical substitution was being made in the curriculum of the schools that had started in the hearts of the people some years hence. Brother science had grown up. The effects of his quiet museings were beginning to appear in every corner and cranny of the Western world, and the people were beginning to fall to his spell and his stories of deeds done and deeds possible to do. Underhill (1941) observes that during these years:

> Eminent scientists were giving popular lectures to large audiences. They felt that the vast discoveries in modern science should be a part of general education, and advocated that sciences be taught in the early grades of the elementary school (p. 98).

Science was becoming increasingly accepted and welcomed. Religion, tradition and folk culture were fast dying--though some felt they were dying too fast. The doors of educational curricula were finally opening and science was marching in. It was at this point that a peculiar, and I believe a far reaching substitution was made. The classical language was exchanged for the language of science in the schools. The extent and consequences of this mate swapping are only now becoming discernible, but a glimmering of this reality was captured by Underhill some forty years ago. The swap began when academicians began realizing that science could be used as both a utilitarian and disciplinary subject. Underhill (1941) writes:

> The rapidly growing industrial expansion, based on rapid progress in both theoretical science and applied technology, resulted in science being looked upon as a 'practical' as well as a 'cultural' or 'disciplinary' subject. This influence furnished strong support for increased science teaching in the schools (p. 93).

He continues, "Science similarly gained great support, both from those who saw in it a substitute for the classics as a liberalizing culture, and a means of training the mind, and from those who were impressed by its practical value." The methodology of strict teacher control and mind training could be maintained through the sciences.

This is an important concern. The instruction of the sciences gained strength because it was found that the language of science could replace the language of the classics in the rigorous training of the mind. The academic

tradition had not once moved from the philosophy that the purpose of education was mind training. In the Middle Ages, this mind training was to produce clergy and the refined companions of the nobility; in this time a new goal was assumed, as the power began to shift toward the industrialist and the scientist, and this new emphasis helped strengthen the science curriculum in schools. The method of instruction never changed, only the topics. New theories of learning were expounded to support the existing form of instruction. Educators began talking about the value of "faculty psychology" as a theory that gave credence to the idea that the mind worked like a muscle that was in need of academic exercise. Fowler (1978) writes, that in the period from 1880-1920:

> Faculty psychology dominated the scene. A movement supporting learning for learning's sake and for the discipline of the mind was in evidence. In relation to faculty psychology, science was considered particularly useful to discipline the mind. Science could be used, it was argued, to train students in developing systematic habits of work, a power of reasoning, and both precision and neatness. The laboratory enjoyed a popular support and perhaps even an introduction as a part of many new secondary schools science programs. To further the course of "discipline of the mind" it was argued that in science one accomplished this because of science's formal and systemized subject matter as well as a result of involvement in laboratory work (p. 91).

Laboratory instruction developed during this period but as Lacey (1966) notes, it was too narrow, formal and highly specialized with little practical value.

It was not long before disenchantment with this age old mechanistic model of academic education would again

begin to be heard, and the cry for a useful popular education arose. Increasingly, the American people wanted a curriculum that was concerned with the affairs of every day life. They wanted education to recognize the individual--the other old appeal of Comenius. This led to the Progressive reaction, which is listed on Figure 5.

The Progressive Reaction

Beginning around 1910 a widespread rebellion was gathering force against the traditionalists. This movement was to continue to gain momentum, despite opposition, into the fifties, until Sputnik rudely stole its steam. During this time there was increased emphasis on both the individualization of instruction and the development of a curriculum that had social utility. The emphasis was against mechanized formal instruction.

In the elementary schools the Nature-Study program arose. Underhill (1941) states, "The leaders of this movement were attempting to express their acceptance of a theory of the educational process based upon the philosophies of Rousseau and Froebel and their interpretations, as opposed to the traditional form of catechism and memorization" (p. 167). In the secondary schools the Progressive Educational Association (PEA) was active in the reactionary attack. There were also several important documents from the National Educational Association (NEA) during this period. In 1918 the Commission of the Reorganization of

Secondary Education, appointed by the NEA published its famous "Cardinal Principals of Secondary Education." According to this document educators should contribute to (1) health, (2) command of fundamental processes, (3) worthy home membership, (4) vocation, (5) citizenship, (6) worthy use of leisure, and (7) ethical character. In the 1920's the NEA Commission published its bulletin, "Reorganization of Science in the Secondary Schools," which after criticizing prevalent practices in science teaching, urges that the sciences be organized and taught in accordance with the "Seven Cardinal Principles" (listed above).

Some progress was made. The project method gained some force as a means of letting students do some work outside the classroom, and text book writing was seized from the hands of the scientist and temporarily placed in the hands of the educators.

However, grave problems arose both in the implementation and interpretation of the "Seven Cardinal Principles" and related documents. In retrospect it must be conceded that in the sciences, attempts to achieve a utility in instruction degenerated into a mere reference, in a frozen college curriculum, to the social usefulness of science and technology, and a growing praise of the scientific method. The result was that the method of science became increasingly deified, but science itself remained something that scientists practiced, not average people. The scientific method was viewed as abstract method used by the leaders of

our country to bring about wonderful modern progress. But what could the average man do with science? Instructing the social utility of science was taken to mean the development of an appreciation of how men can fit into the technological world that was arising around them, and how they could become socially useful. The opposing view of instructing socially useful science would be to teach those sciences that allow man to relate to his immediate environment, that permit him to participate in an active sense in the creation of the social world. This perspective asks, how can science be useful to man in his constructing, not how man can become useful to that which is being scientifically constructed. This sort of science did not arise out of these times. Social utility was translated in terms of gesellschaft instead of gemeinschaft. The science curriculum, though somewhat individualized, continued in the academic tradition. The PEA (1937) says of this time:

> Though modern psychology has given experimental proof that the conception of mental discipline is inadequate, much of current science teaching is not only congenial to this outmoded theory, but can be justified only in terms of it. The all too prevalent practice of requiring the memorization of fixed quotas of factual material, the assigning of problems selected primarily for their difficulty, the attention to abstract reasoning--all out of relationship to life situations--are evidence of the persistence of the faculty theory of mind and its correlative aim, mental discipline (p. 9).

A large part of the trouble with effecting widespread educational curriculum changes during these times was the lack of teacher training. Though statements of how to

accomplish social reconstruction was printed, implementation was rare, and it became increasingly difficult for an instructor (of high school chemistry for example) to determine clearly how he should proceed in adapting his curriculum to fit socially useful ends. This problem was intensified by the lack of clarity in the progressive movement itself.

In this period the people's fascination with science did not waver. Courses became organized around the "big ideas" or "broad concepts," which were to help unify the previously scattered bits of scientific data. The Eight Year study of Wilford Aiken (1942) gave progressive schools some new found freedom from total college domination. It was found that graduates of progressive schools equalled or surpassed their traditional school counterparts in their academic work at college, and excelled their counterparts in student campus leadership. However, though a student's early years of secondary science instruction allowed some flexibility to adapt to the interest and needs of the students; the later years of instruction in chemistry and physics were still geared toward preparing students for the traditional instruction found in the colleges. Nevertheless, individual science educators did find considerably more freedom in this age. They wrote the text books and by and large designed the curricula. In 1957 this was to change.

Sputnik

In 1957 the Soviets launched Sputnik which gave birth to an educational epoch that has been termed by Fowler (1978) the Sputnik Era. Sputnik launched the National Defense Education Act (NDEA) of 1958 and sent the newly formed National Science Foundation (NSF) into rapid motion. Both activities were designed to gird up the loins of endeavor of the American scientific community toward the American public education system. Educators were dethroned from the position of text book writers, and scientists were brought in. What followed was a series of alphabetic programs: TSM, ESCP, BSCS, Chem Study, CBA, IPS, PSSC, HPP and ECCP--acronyms of longer titled projects in curriculum. These programs, some of which are still in existence, had as their common purpose to intensify the science curriculum during a perceived crisis of national emergency as the two Spartan super powers began to clash in a race for scientific supremacy. Much more emphasis was given to the process of science, while the subject matter of the courses was raised to a higher level of cognitive engagement and attempts were made to give a more thorough and deep treatment of scientific concepts. Though deliberately trying to win student favor and interest, most of these programs did not significantly explore the applications of scientific technology for the common man's use. Essentially educators returned to commanding a more strict obedience from their

students, and the language which the students were to master was that of science. Science had become extremely important. The state demanded an increased flow of trained scientists to maintain the race of Western civilization.

The Dangers of A Secret Language

Two hundred years ago, as two thousand years ago, the mark of an educated man was the ability to read, write and speak the classical language. It was a language that was unintelligible to the majority of the populace, and this somehow rendered the user of this language special; it was in a sense a secret language, and its users were possessed of secret knowledge. Today a new secret language--the symbols and expressions of science, have been erected on the pedestal where Latin and Greek once stood, and the ability to communicate in these forms is now generally considered the mark of an educated man. There is nothing inherently wrong with the development of this new and valuable language. The danger lies in the human user of this language, and the effects its use has upon him and society. It has to do with the struggle of men for prestige.

The possessor of a secret language has always been granted a position of status in society. There is a social reward for his having acquired word-power, and herein lies a trap for educators and students. Learning specialized or "secret" words is reinforcing of itself. It is reinforcing because it elevates the learner's status, even if only to

himself, by virtue of having learned a secret word, and the use of that word often brings reinforcement from those around him. Everyone knows the thrill of dazzling your friends with a new word you have mastered, and every parent knows the excitement of hearing their children acquire increasing vocabulary. Thus, words have power, and teachers of words have greater power.

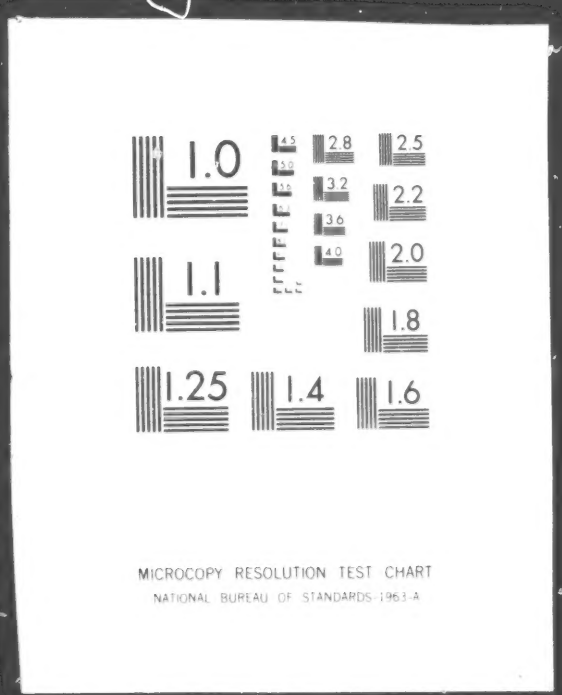
The academic tradition as we have observed, has proven to be very stable over time. It sustains attacks even by masses of people over many years. It has stoutly refused to concern itself with the immediate daily concerns of the populace at large. Though it may claim, and justly, to be a trainer of the leaders of men, the academic tradition has never consented to carry its learnings out in the street and be put to use by and for the common man. Most often I fear, academicians would not know how to begin this task even if they wanted to. The social walls between the "masses" and the "learned," or between instruction and utility are too high. Millennia have been spent in building these walls between academic education and daily living. The academic tradition is plagued by the Ivory Tower syndrome. Life in the streets goes on, while thinkers in the towers soar into intellectual interstellar space, but they cannot easily make the transition to more helpful innovations outside the walls. Innovations do occur, especially in recent years, from academic study; nuclear reactors, atomic bombs, and thousands of advanced technological gadgets from televisions

to fancy automobiles appear in rapid succession. But these products invade the masses, they descend upon them from the world above and outside of their world, from the mysterious land of scientist and technologists. The products may be helpful, but they may also make a man feel like a stranger in his own world. The technologists are fond of producing such change, as the act of creation is reinforcing by nature. The secondary schools as preparatory agents for the colleges, and the colleges as the training place for industrial scientists, which as schools operate within the academic tradition are able to maintain this tradition despite its unsatisfactoriness largely because they are able to train these technologists. The student who can survive the abstract process of academic word-bestowal and retrieval, which is the prime activity of the science classroom, does so because the intrinsic reinforcement of the learning of the "secret words" of science and the rewards of increased earning power, status, and creative power that is potentially available to the graduate are able to sustain him. Present science education in these schools, because it remains within the ancient academic tradition which has never been concerned with the affairs of the common man, continues to alienate the common man even though it is an education that is supposedly designed to serve him.

The current science curricula of upper secondary schools and colleges cannot be acceptable because (a) it subverts the possibility of students performing any real

work in the environment until after many years of schooling, (b) the process of formal academic science instruction ignores the interests, and curiosities of the learner, and (c) a discussion of the ethics and human responsibilities of creating change in the environment has never entered into the curriculum. Academic science education as practiced increases the polarization of society into the technocrats and their servants. This is especially so because there is no compulsion, other than moral, for the trained scientist to take the knowledge he learned to the streets of the common man. Further, as science becomes increasingly specialized and dependent on costly apparatus, there is precious little knowledge that can be brought to the streets and adapted for the use of the common man. The common man becomes a pawn to technology, and the technocrat, without a balancing ethic, becomes an arrogant and haughty individual.

Teachers in our society are granted a position of power via their command of words. Little demand of social accountability is made on them. Publication is often required of college faculty, but often these writings are only read by people within a narrow field. The educator is often far removed from contact and dialogue with the public. The teacher is not compelled to work with the public except within a narrowed sense. The teacher recognizes eligible members of the public only within the confines of the accepted rules, and regulations of the traditional academic class. In this class the status of the teacher is securely maintained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MICROCOPY RESOLUTION TEST CHART
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via his conducting the process of word bestowal--a process that teachers have maintained absolute and rigid control over. This is one reason why changing the methodology of instruction is so hard, and why trends such as those advocated by the faculty psychologists are hard to alter. Another reason is that many teachers do not know anything but words or do not know how to make the transition from the Ivory Tower to the fields beyond.

In the Middle Ages teachers were concerned with the almost alchemical process of transforming their chosen ones (students) into purer "learned" beings. To accomplish this task, teachers were free to use whatever method was at their disposal to still the wandering interests of the learner, and fill his mind with that privileged knowledge which would grant status, power, and future prestige. Similar to sorcerers, educators have fascinated youth with the glowing ball of special knowledge that was offered to youth only on the terms of the educator. The rebellious student was prodded to continue the mystic chanting, whether a Latin mass, a Greek verb conjugation, a formal catechism, or today a biochemical pathway. The student continues to play the game of academia because he is assured that if he can quell his native interests long enough, then he can achieve a rank or degree in the society.

Today this formal game of academic mind training continues in full tradition in the universities, and to a lesser extent in the secondary schools. It must be stated

that there is some value in this process. The thrust of my argument is not that those things that require memorization, whether a Greek verb conjugation or a biochemical pathway not be learned. But for many students the opportunity to use this knowledge, to work change in their environment, to create a socially useful product, has been removed from the arena of study, and either ignored or perilously restricted to the sterile halls of the Ivory Tower from where it cannot be transferred. In recent days there is the added complication that there are few remaining natural communities in which students can perform socially useful work. We have been totally industrialized by two thoughtless brothers: the brother industry, who occasionally lacks patience and wisdom; and the brother science who often displays alarming lack of balance.

The Effects of the Modern Secret Language

Academia in the Middle Ages proceeded in the Ivory Tower, and the relatively few participants in this education possessed no real threat to the stable order of society for the masses. Their presence often added color and they filled a valuable role by preserving the culture's history. But this is before the days of brothers science and industry. Today the structure of society has remarkably changed, and most people are deprived of the stabilizing contact with the earth. The space satellite Sputnik is a remarkable symbol for this age. It is the agent that

strengthened the bonds in science to the academic tradition, and took away much of the educators' freedom as being dangerous in the face of the larger concerns. It was Sputnik, a product and symbol of science, that served to push us toward a greater commitment to science. Science pushes science into the future. It is the comet to the stars. There is something in this modern scientific adventure that differs from the ancient pursuit of science. It is as if we; our society, our homes, our culture, our lives--all that was once born of earth, are somehow being rearranged and packed into that satellite for orbit.

There are marvelous benefits to this style of life. It is remarkably asceptic--of necessity for a space craft. Therefore, many physical diseases are fast declining in the Western world. Cleanliness and order prevail in many modern areas; in neat office buildings that look like rockets, we look down over ordered industrial parks, turnpikes, and shopping malls. We shuttle back and forth from these outposts in special air conditioned vehicles. But there are severe disadvantages as well. In a space community, there is no safe place to venture between space settlements. Similarly, in many cities there is no safe place to roam and enjoy nature between destinations. Travel is even done in cars that strongly resemble space craft with their necessary life support systems (air conditioning and windows to shut the outside world out). Even our view and contact with the earth is becoming increasingly restricted. We view

the earth from above it or from the inside looking out. We can traverse thousands of miles, watch the earth turn below us, yet we can feel cramped for space, shut in. We are becoming completely compartmentalized. Like a space craft, there is a compartment for everything. We have a work compartment, a home compartment, an exercise compartment, an emotional compartment, an entertainment compartment, and a schooling compartment where we train the mind of man. The students trained there are often bright, but are they sane? Are they rational? As Fromm (1955) notes, "In observing the quality of thinking in alienated man, it is striking to see how his intelligence has developed and how his reason has deteriorated" (p. 154). This modern satellite that man lives in is a self-contained world. Everything is available for man to consume, provided he can obtain capital. There is very little that man must produce, or only a small piece of the total production that he must perform. Indeed, students need not produce anything at all in society. The result may be psychologically disasterous. We produce children that look healthy, that are attractive, but who may not be balanced in personality. This modern alienated man has some peculiar characteristics. Fromm continues:

> He takes his reality for granted; he wants to eat it, consume it, touch it, manipulate it. He does not even ask what is behind it, why things are as they are, and where they are going. You cannot eat the meaning, you cannot consume the sense, and as far as the future is concerned--apres nous le deluge! Even from the nineteenth century to our day, there seems to have occurred an observable increase in stupidity, if by this we mean the opposite to reason,

> rather than to intelligence. In spite of the fact that everybody reads the daily paper religiously, there is an absence of understanding of the meaning of political events which is truly frightening, because our intelligence helps us to produce weapons which our reason is not capable of controlling. Indeed, we have the know-how, but we do not have the know-why, nor the know-what-for. We have many persons with good and high intelligence quotients, but our intelligence tests measure the ability to memorize, to manipulate thoughts quickly--but not to reason (p. 154).

There is yet another, even more frightening characteristic of spacecraft living, and that is, if one believes strongly enough that spacecraft living is a necessity, one will resist any attempts to change it. You do not pull the plug of a spacecraft because if you do it shuts off, and if you are an inhabitant of it, you shut off with it. There arises in the American populace the feeling based on fear, that we cannot stop the technological race into the future, and haven't time for diversions from this straight path in the curricula. As we have mentioned, current technology does not require simple tools, but relies upon sophisticated, complex and costly equipment. To maintain this equipment requires specialists, not of the affairs of simple living but of advanced technology, and the schooling of advanced technology need not be based on ground level interactions, and in fact need not be based on any forms of material production, but on the eventual development of an area of expertise.

The man of antiquity in natural schools began by learning a single ground level skill at an early age, and

increasing his skills and knowledge with age. Modern man in academic schooling begins by trying to build a broad conceptual base, upon which he gradually narrows his interest and focuses in on one area of concern before he actually begins work in the environment. As a student progresses in the study of modern science, he acquires the increasingly narrowed vocabulary of his specialized field. Mumford (1970) notes:

> The sciences are now so specialized in their vocabulary, so esoteric in their concepts, so refined in their technique, and so limited in their capacity to communicate knowledge to non-specialists even in closely related fields, that non-communication has almost become the badge of vocational superiority among scientists (p. 264).

This modern, academic, word-centered training that is offered to the youth in their studies of science in the schools accomplishes a continued partitioning of the populace into ever smaller groups of specialists.

In the Middle Ages, only a small percentage of the populace could gain entry into the hallowed ranks of the leaders of church and state. Today an equally small percentage of people can gain entry into the high levels of position in the technocracy. As Galbraith (1971) observes, "Power (in society) goes to that factor which is hardest to obtain or hardest to replace" (p. 70). In the Middle Ages this power was associated with the priesthood via their knowledge of the written word. Now it lies with the technologist. The students who realize this compete fiercely to obtain these few positions of power and

security. Many other students will graduate with a supposedly well-rounded education, but must adapt their interests to the society that technologists mold. The thousands of students who do not wish to sacrifice years of their lives to the reading of books and the memorization of formulas without meaningful interaction with the earth and community, opt out of the system and search for anything that looks like it can withstand the stormy ride into the future. This leads some educators like Thomas Tanner (1970) to ask:

> Shall the technological revolution be directed by man for the greatest common good, or shall it sweep us all along toward an unplanned and unthinkable brave new world? (p. 353)

There are many aspects of man's faith in technology that approach religious fanticism. Mumford (1970) observes:

> When an ideology conveys such universal meanings and commands such obedience, it has in fact become a religion, and it's imperatives have the dynamic force of a myth. Those who would question it's principles or defy it's orders do so at their peril... (p. 157-158).

Tanner (1970) observes:

> Implicit in all this is a charge for the educator: A society which has replaced an unquestioned faith in God with a hindsighted faith in science and technology has not made a very significant intellectual advance. Overfaith should be accorded the same derision as overkill (p. 354).

Has it never entered our minds that we as science educators may be following in the footsteps of the church fathers of the Middle Ages as we carefully construct our lessons around the sacred words (concepts) of science, demanding recitation and memorization, yet remaining blind to the signs of social

upheaval that surround us and are, at least in part, due to the inadequacy of prevailing social doctrines to meet the various human needs. Has science become the new church and technocracy the new state? Are science teachers then its priests?

Modern man in this precarious situation continues, as Carl Jung (1933) notes, to play naive to the full motives and consequencies of his actions. He writes, "... spiritually the Western world is in a precarious situation--and the danger is greater the more we blind ourselves to the merciless truth with illusions about our beauty of soul" (p. 213). Have we allowed the trumpets of sciences' glorious march into the future to mask the social consequences? Is the science curriculum serving the function of selecting souls for membership in a new church and state. If this is so, then when was it decided that this is what public education should be? Does the future vision being painted by the proponents of current scientific and industrial practices, from Lord Snow to B. F. Skinner, reflect an awareness of the totality of man's needs? Or are teachers and students led forward by the tantalizing but incomplete vision of a futuristic land of leisure made possible by firm commitment to science, where guided by pure intellect man will amuse himself, and spend his time fondling his enlarged sexual appetite, free from procreation, and basking in his own litany of scientific accomplishments. Is this not the image portrayed in the heroes of the countless star movies that have become so

popular these days. Yet, recall in these films the dark planet, raveged by war, torn with pain, at times looking remarkably similar to earth. On this planet resides the people who could not get off it before the nuclear holocaust. They were the unskilled masses, the earth people, who were not choosen for the trip into the future aboard a fleet star-craft. Is this the destiny of man? If it is, it will have happened because the few have forgotten the many. Brother science and brother industry took the mystical ball of secret knowledge in the late eighteenth century and ran with it. They never brought it home to serve the community of man. To date there has never been a true sharing of science with man. Years ago our parents used to huddle anxiously around the television and watch the evening news. They were concerned with our troubled planet, and watched the news in passionate hope. Today it seems to me that many youth and young adults do not concern themselves with the affairs of the world. Instead they gather and watch the evening star movies. They have abandoned all hope for social reconstruction and fled to the stars where it is less painful and more glamorous. Nothing remains below, but those who could not get off. There is only one problem. We are really still here! The tremendous danger and allure of science fiction is that it can create the illusion that we are where we are not! It is the plaything of a people whose science is not grounded in the human concerns of the society they are building.

CHAPTER IV

SUMMARY AND PROPOSALS

Spiritual Problems of the Modern Scientific Society: A Summary

Many people from Jimmy Carter to Alexander Solzhenitsyn, from Ayotollah Khomeni to Dwight Eisenhower have attempted a spiritual analysis of the Western world's troubles. I will also offer an analysis. In addition I will conclude with some specific proposals related to science education. I, like many of the authors I have quoted (Fromm, Henry, Jung, Mumford, Schumacher), feel that the core of modern man's problems are spiritual in origin. To guide my analysis I will use the Baha'i teachings as a point of departure. This is partly a matter of convenience, because as a member of the Baha'i Faith, it is these scriptures that I am most familiar with, but it is also a matter of the consideration of the unique claims of the author of this Faith.

In retrospect it would seem as though the winds of change suddenly unleashed their fury over the face of mankind some two hundred years ago; causing most everything that was then known as stable in the world to begin to shift. I do not believe this occurrence was accidental, but was rather like the latent onset of puberty that lies sleeping in the

youth until its powerful forces become aroused. Mankind has always been moving toward the scientific revolution, and the forces with which science and industry toy are as powerful to society as the hormonal forces of puberty are to the adolescent. Both forces have the power to change things, and these powers can be both properly used and misused. Both man individually and society collectively experience these forces first hand, without prior knowledge of their potency. But with the skillful guidance of parents the youth may grow to understand these forces and appropriately channel their energy. Modern man is also in a state of adolescence. He is involved in the same petty bickering that children have always been involved in; however, the size of man's anger and the potential force of his blows now represent a much greater cause for concern to the continued existence of mankind. But where is mankind's fatherly guidance? According to the Baha'i teachings both the forces and the guidance necessary to properly use these forces were released into the world over a century ago. It is therefore, to these Writings that I turn for an analysis of the current world situations with respect to both science and instruction.

In the previous chapters we attempted to catch a glimpse of some of the forces that animated the construction of the modern Western world. We identified the beginnings of this construction with the growing industrial and scientific revolutions which applied knowledge to the societies of man. We examined the appeal of science in an

age of authoritarian religious strangulation of the thoughts of men. We noted the early ideological tendency of science, and witnessed the emergence of a capitalistic spirit in man that used the tool of science and the apparatus of industry to rearrange the elements that constituted the pattern of life for most of the people of that day. We observed the good that came out of this industrialization and remarked on the changing personality of man. We traced the evolution of schooling, both academic and natural, and noted the ancient ties of academic education to the transmission of the symbols and written words of a society and their use by a privileged elite. We expressed the fear that a powerful elite may be forming, armed with the even stronger symbols of science and technology, and that our curriculum seems to take no account or questioning of this process. Nor does it offer alternatives. We have tried in the foregoing chapters to climb a small knoll of perspective and look searchingly into the past to determine the nature of the path on which we have been traveling. Having done this I am now ready to make some statements and to examine some ideas for an alternative science curriculum.

I do not believe that the road our society is taking is a safe road. I think it is a perilous road, and I take the current state of world affairs as evidence of this. From my small knoll of perspective, I perceive at least three spiritual laws that our society has violated in the building of the modern West.

I. The Loss of a Balancing Integration between the Domain of Science and the Domain of Religion

Like the swing of a pendulum, I believe man has moved from a period of religious fascination, during the Middle Ages, to a period of scientific fascination in the present day. In the school of the Middle Ages, science was an unwelcome guest. Today, religion is equally unwelcome. I think both situations have led to an unblanced condition of both society in general, and the individual in particular. The Baha'i Writings express this theme in the following manner:

> Religion and science are the two wings upon which man's intelligence can soar into the heights, with which the human soul can progress. It is not possible to fly with one wing alone. Should a man try to fly with the wing of religion alone he would quickly fall into the quagmire of superstition, whilst on the other hand, with the wing of science alone he would also make no progress, but fall into the despairing slough of materialism (Abdu'l-Baha, Paris Talks, p. 143).

However, it is not just religion that has been excised from the classroom, but the experience and expression of the subjective nature of man that was so important to the religious life of the past. Like Lewis Mumford, I believe that in our historical pursuit and love of the mechanical orderliness of science, we cast out the subjective part of our natures: the poetry, the art, the expressions of religious awe, the desire to live in harmony with a nature that beats with the pulse of God. Mumford (1970) writes:

> If science as conceived in the seventeenth century had embraced all the phenomena of nature, including man himself, neither the theologian, the mystic, the lover, nor the poet would have been so preemptorily exiled in the beginning; nor would it have seemed possible to suggest as many besides Herbert Spencer have done since, that science, if pursued more universally and rigorously would finally eliminate them (p. 94).

II. The Violation of the Natural Limits of a Safe Application of Scientific Advances

There are some limits to progress beyond which technology becomes uncontrollable. In the 1860's Baha'u'llah (an Arabic title meaning "the Glory of God"), the Inaugurator of the Baha'i dispensation wrote:

> The civilization, so often vaunted by the learned exponents of arts and sciences, will, if allowed to overlap the bounds of moderation, bring great evil upon men. Thus warneth you He who is the All-Knowing. If carried to excess, civilization will prove as prolific a source of evil as it has been of goodness when kept within the restraints of moderation ... The day is approaching when its flame will devour the cities.... (Gleanings from the Writings of Baha'u'llah)

Today, we seem to have somehow lost control over much of our lives. Technology pushes us, as a tractor would, into the future, and though we can perceive that we are heading for a large cliff we cannot gain access to the throttle. As Ivan Illich (1973) suggests:

> Society can be destroyed when further growth of mass production renders the mileau hostile, when it extinguishes the free use of the natural abilities of society's members, when it isolates people from each other and locks them into a man-made shell, when it undermines the texture of communication by promoting extreme social polarization and splintering specialization, or when cancerous acceleration

> enforces social change at a rate that rules out legal, cultural and political precedents as formal guidelines to present behavior (p. xi).

Most of the leaders of the early industrial and scientific revolutions were eagerly and honestly engaged in the promotion of what they thought was the common good. I am not sure that we can share this innocence with them today. Like John Steinhart (1972) I must ask, "When at present, a large portion of our economic growth in advanced countries simply increases material well being, far beyond survival without ending poverty, it ceases to be clear what the objective is" (p. 11).

Our industrialized society offers many incredible gifts to parts of the world's population, but I am not so sure that ours is not a Trojan Horse gift. It seems that many Eastern and Third World countries have also come to this realization and are hesitant about what and how they accept technological gifts from the West. Our gift is certainly not free. Not to ourselves, and not to others. Our materialistic philosophy seems to destroy people from within. It affects our self-control and appetite. As economist E. F. Schumacher (1973) notes, our desire to consume and have others consume with us is marred by a serious flaw. He writes:

> The dominant modern belief (in the necessity and advantage of spreading material wealth) has an almost irresistable attraction, as it suggests that the faster you get one desirable thing the more securely do you attain another. It is doubly attractive because it completely by-passes the whole question of ethics (p. 23).

We in the West have become convinced, as Schumacher (1973) notes, that "the problem of production has been solved; that mankind has at last come of age" (p. 13). We feel that our task now becomes, "education for leisure and for the poor countries ... the transfer of technology." But this puts us in the position as Illich (1973) notes, of "humanitarian liberals who have come to feel that feeding the starving millions is their (our) vocation ... (and this) makes other peoples survival depend upon our growing efficiency" (p. 48). Though we may look with delight at the immediate product of our powerful technological inventiveness, I am not confident that we are willing to look, except with myoptic vision, on the long term social effects of our supposedly harmless inventions. If we persist in this short sightedness, then I, like Carl Jung, must question the purity of our motives in this technological expansion and its accompanying change in our way of life.

III. The Growing Dependence on a Powerful and Specialized Word-Centered Education, to Train Specialists and Leaders of Industry, to the Exclusion of a Practical and Useful Education for the Common Man

The breaking of this third law is addressed more specifically to educators. Baha'u'llah states the law this way:

> Knowledge is like unto wings for the being (of man), and is like a ladder for ascending. To acquire knowledge is incumbent upon all, but of those sciences which may profit the people of the earth, and not such sciences as begin and end in mere words.

The instruction of science in modern times certainly produces individuals who are capable of producing remarkable effects in the world. But is this instruction such that it can be said that it truly profits the peoples of the world? And does not the study of the sciences for many people end up as a life-long occupation with words--words that are divorced from the concerns of the majority of the peoples and day to day living.

It seems that modern mass education, which remains primarily in the academic tradition, actually supresses the possibility of any sort of socially meaningful participatory science for the students, who are drowned in a sea of words. While the right to use science for significant social ends seems to be reserved until periously late in the life of the individual, and even then its use is restricted to those successful few who go on to become technicians of some giant interconnected industrial machine. The result of this exclusive word centered education which keeps youth from meaningful interaction in the environment, is to extend adolescence late into life. Figure 6, obtained from Mary Budd Rowe (1980) and the National Science Foundation, shows the expanding period of adolescence in our modern society. Adolescence which was in preindustrial time largely a biological process, becomes through the industrial revolution and into the present time, an increasingly social process, as the work that was to define adulthood is postponed until

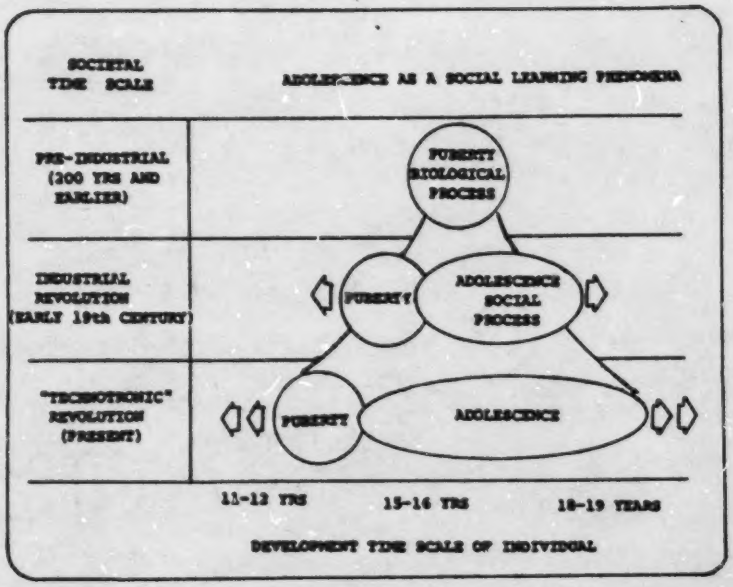

Figure 6. Adolescence as a social learning phenomena.

increasingly later in life. In addition, the chart shows onset of puberty occuring earlier in the life of modern man.

In recent years there has been increased emphasis on what has been called the "process skills" of science, in part to allow students to participate in the activity of science and to remove them, for at least part of the day, from the formal catechisms of science instruction. Though

valuable, (research also shows that participation in process skills may enhance cognitive development) for the student this amounts to little more than play acting science if it is not coupled to the learning of some content that is conceivably marketable--that has demonstrable social utility. Unless a student is learning real, socially valued, "adult" skills, then we cannot expect to truly engage a students interest or pull him out of a prolonged period of adolescence. Unless science instruction transcends the Ivory Tower, the student is trapped in a position where all he can do is consume what is offered to him, with no time or support for him to consider how he can use such knowledge to help contribute his part to world building.

The sign of the student's social value is confined to his ability to earn a "letter grade" from his teacher, and his ability to use the instructed science skills is limited by the physical constraints of the schooling process--the schedule, the walls, the lack of materials and direction. Science teachers continue to instruct science as if mastering the concepts and process of science is of great value to the student. But is it knowledge that allows its possessor to produce and create a desirable society? As H. S. Broudy (1972) recognizes:

> The complacency with which science educators promise that knowledge of science will result in application of science should be shattered not only by the lack of scholastic achievement in science and technological competence, but in the inability of the well-educated men to cope with the failure of their household appliances (p. 5).

How many college graduates find themselves bereft of tangible skills?

PROPOSED CORRECTIONS AND BALANCING FORCES

If spiritual laws have been broken and men have not taken the time to correct the drift of their society which has now wandered into strong seas, and if this breaking away from the previously excessive constraints of religious tradition and a land bound existence has been excessive and has been accomplished chiefly through the influence of a rising scientific and industrial strength coupled to the spirit of emergent capitalism, then a science curriculum must address in some fashion these broken laws if the ship of state and society is to find calm seas. As E. F. Schumacher (1973) suggests, "If Western civilization is in a state of permanent crisis, it is not far fetched to suggest that there may be something wrong with its education...." (p. 80).

The proposed curriculum and philosophy of instruction therefore aims at the accomplishment of three tasks:

1. the elimination of the alienation between the scientific and religious part of man--between the empirical and subjective part of his nature;
2. the recognition of the safe boundaries of the practice of science, and
3. the modification of a word-centered academic education to encompass the practice of utilitarian science.

To accomplish these changes the educator must rely on two balancing forces that are seldom tapped in the schools of today. These forces are those of freedom and responsibility. In the "land of the free" it may sound strange to talk of the lack of freedom in the schools, though there is a profound lack of this quality in most upper secondary and college science courses. This is in part a by-product of the fixed curricula, which evolved in the high schools in an era of college domination, and in part due to the fascination of teachers with maintaining control of the ancient process of word bestowal through the limited methods and belief in faculty psychology and mind training. The method of formal academic mind training that persists into today both simplified the task of instruction, often to the point of rigidity, and maintained the teacher's status and position in society. Thus the teacher may be guilty of bending the students to fit traditional molds for subtle but selfish and egotistical ends.

In the traditional academic system, Maria Montessori (1976), a brilliant innovator of educational practices notes:

> Young people in the secondary schools are compelled to study as a 'duty' or a 'necessity'. They are not working with interest nor any definite aims that could be immediately fulfilled and would give them satisfaction and a renewed interest in continuous effort. They are directed by an external and illogical compulsion, and all their best individual energy is wasted (p. 100).

Teachers maintain the rigidity of this process with the trinkets of symbolic rewards (letter grades) and the promise

of the social rewards that lie at the end of the process for those who can persist. Montessori continues:

> Adolescents and young people almost right up to maturity are treated like babies in the elementary schools. At fourteen or sixteen they are subject to the petty threat of 'bad marks' with which the teachers weigh the work of boys and girls by a method that is just like that of measuring the material weight of lifeless objects with the mechanical aid of a balance. The work is 'measured' like inanimate matter, not 'judged' as a product of life (p. 100).

A curriculum that wishes to break this mold of regimented instruction, must force some freedom into the process. I say "force" because, though it be ironic, I feel that in this land of freedom, most students do not know how to handle freedom in the classroom. They have not had it, and they will have to be taught how to use it.

The balance of freedom is responsibility. The responsibility the students now have in the classroom is a small variation from the responsibility that students of academic education have always had. Theirs is still largely the task of memorization and concept retention, recitation and academic problem solving. This study, as Montessori (1976) notes becomes:

> ... a heavy and crushing load that burdens the young life instead of being felt as the privilege of initiation to the knowledge that is the pride of our civilization. The young people, the men of the future are formed into a mold of narrowness, artificiality and egotism. What a wretched life of endless penance, of futile renunciation of their dearest aspirations! (p. 100).

The sort of responsibility that the new curricula must advocate is a responsibility to use freedom wisely in the

pursuit of their dear aspirations, and to perform as responsible, active community members of the school.

THE GENERAL NATURE AND OPERATING PRINCIPLES OF THE COMMUNITY-INTERACTION SCHOOL

A school is needed that will meet some of the challenges put forth in this analysis, that will force off the yoke of academic tradition that seems destined to carry us into an uncertain technological future, and will explore some alternatives. It must be a school that seeks to recapture some of the harmonizing principles that have been lost from our communities in our trek to the present technological society. It must be a school that attends to and tries to hear some of the predominant symptomatic maladies of our time. It must be a school that tries to rekindle the vanishing spirit of community, and attempts to teach people those skills that allow small groups of people to work beneficial changes in their environment so that they may begin to regain a sense of control in their lives. It must be a school that is more in the spirit of the ancient natural schools, and one whose curriculum is more concerned with community and ground level interactions.

A school is proposed that would be called a "community-interaction school." The school is so named because the emphasis would be on the youth's interaction within the community environment and the consideration of the needs and problems of this community. The word

"interaction" is important as it indicates the desired switch from a word dominated curriculum, to one that involves plans, activities and projects that are of immediate value to a community. The student's role in this school is not one of passive consumption but active participation and production. The word "community" can signify the school itself (the students, staff, faculty, and parents) or it can encompass a larger geographic region. This area should not be too large, and should fall within natural geographic boundaries if possible. In most cases, if the natural community of a locale has already withered, the sense of community will have to be built from within the school. Fostering the sense of community in the school becomes a very important concern, as it is the deterioration of natural communities that is one of the most painful characteristics of our modern society. I believe that the feeling of belonging to and being responsible for the growth of a community is a necessary condition for the evolution of the social maturity of the youth. The school should therefore put great concern on this priority of community building among its members.

The type of activities of community interaction schools are called "community ground level product interactions." The curriculum is based around these activities. The essence of the thrust of the proposed curriculum changes is that youth be allowed to interact with the "real world" (the world beyond the Ivory Tower, thought it may include

the Ivory Tower), and experiment with their natural talents, and explore their curiosities toward the development of a demonstrable product. Therefore freedom is given to the student to study and engage in those activities that are of interest to him. This is not an absolute freedom, but a relative one. The student and teacher should consult together on the proposed projects, and the teacher should be well aware of the activity of the student. In this process the teacher is not relinquishing control of the classroom, as much as he is altering the process of instruction to adapt to the needs, interests, and curiosities of the student. However, the teacher should not over adapt instruction to the curiosities of the student. Instruction should be a product of the consultation of the learner and teacher. The teacher with his greater experience may deem it wise to compel a student to attend to certain material that the student might otherwise overlook. Teacher lecture is not abandoned; it is not, however, the principal mode of instruction. The focus of the interactions should be on the development of tangible products, developed through interaction with ground-level (available) resources, of use and value to the community. The teacher maintains control of the scheduling of class time, and may, as mentioned, compel students to attend to certain topics of instruction; but the instruction is, in the Deweyan tradition, more individualized and child-centered.

Along with this freedom to study items of interest come two balancing responsibilities: the responsibility

to be actively engaged in the task agreed upon, and the responsibility to share with the class and perhaps the school and larger community the product of the student's endeavor. This second responsibility serves as the critical leaven to awaken a student's sense of social responsibility. The student must account for the use of his time to his peers and his community. He assumes the responsibility of becoming their teacher, of correctly interpreting his results, of effectively communicating his message, and of demonstrating the utility of his cause. If these concerns are not met, the student shares the failure and frustration among his peers, but also reaps their support and encouragement. In his presentations to other students, the student is not delivering a formal catechism, but sharing the product of his investigation and efforts. The teacher is freed from the endless repetition of the same words year after year, but assumes the responsibility of guiding the student, facilitating his study, keeping him on schedule, finding avenues of expression that best fit the student's personality, and coordinating the class affairs.

Accompaning these general changes in the operating character of instruction must also follow the adjustment of the science curricula to comply with the three tasks outlined earlier.

PROPOSALS DIRECTED TOWARD TASK I: THE ELIMINATION OF ALIENATION BETWEEN THE DUAL NATURES IN MAN

In the schools of today it is typical for the students to be herded through the separate classrooms of science, math, art, poetry, physical education and other topics. These disciplines, like the compartmentalization of our lives, are kept separate from each other; they are not allowed to overlap. Students are reminded that science is not art and vice versa. I believe that this is the reactionary effect of Cartesian dualism manifested in the schools and the product of the attempted separation of the subjective and empirical nature of man. I do not believe this separation is natural or healthy. A community-interaction school would encourage the demonstration of the art in science, and the science in art. Both natures of man well out of the same ocean of experience and present complementary halves necessary for a full appreciation and ecology of living. In these schools, classes can still be held on theoretical physics or Renaissance Art, but the interaction between the two will be stressed. Art students should be encouraged to show their works among physicists and vice versa, and a healthy dialogue should be invoked that could involve the whole community as a part of a new celebration of the richness of man's experience.

PROPOSALS DIRECTED TOWARD TASK II: THE RECOGNITION OF THE SAFE BOUNDARIES OF THE PRACTICE OF SCIENCE

As noted earlier the dangers of the scientific spirit emerge when it is not truly linked to human concerns. What is needed is a new definition of what constitutes a fitting goal of science for ecological growth in human societies. E. F. Schumacher (1973) asks,

> What is it that we really require from the scientists and technologist? We need methods and equipment th are
> -cheap enough so that they are accessible to virtu everyone;
> -suitable for small scale application; and
> -compatible with man's need for creativity (p. 34,

The above statement may be perceived as a preposterous attempt to throw science and industry back into the "dark ages." I must respond with several concerns. First of all, the so called "dark ages" were not as culturally and scientifically dark as may be imagined by modern man. As we have noted, man not only survived but prospered using available technology in these ages. He increased his skill in such things as: energy production, metallurgy, pottery, plant selection, medicine, agriculture, tool construction, artistic expression, weaving, dyeing, city planning and management, engineering, navigation and a host of other activities. The weakness of those ages seems to be rather in the constraints placed upon thought, and in a certain staidness that resulted from an eventual cultural inbreeding.

Secondly, a return to Middle Age technology is not being advocated. Rather, I am calling for an assessment of current scientific practices, and questioning the accessibility of these practices for the common man's use. I would like to see the development of tools that more people could use to conduct their own scientific research, and to begin directing their own affairs. I hope that we will learn from the mistakes of the immediate past and evolve out of the fascination and enslavement to megatechnics, and into a more ecological personal and social stability in the future. It is not backwards that I wish us to go, but forward. I wish us to carry our acquired skills and use them in a offering to the freedom and dignity of mankind. Illich notes that such a society is now hard to envision. I believe our faith in modern technology and science has bent our imaginations to conceive of only the technological gadgetry and sensual thrills that become possible through science and technology when we think of the future. Illich (1973) writes:

> Paradoxically, a society of simple tools that allows men to achieve purposes with energy fully under control is now difficulty to imagine. Our imaginations have been industrially deformed to conceive only what can be molded into an engineered system of social habits that fit the logic of large scale production (p. 15).

I must admit, as Illich (1973) does, that history has proven that science can be as prolific a source of harm as it can be of good. He writes:

> Scientific discoveries can be used in at least two opposite ways. The first leads to specialization of functions, institutionalization of values and centralization of power, and turns people into

> accessories of bureaucracies or machines. The second enlarges the range of each person's competence, control, and initiative, limited only by other individuals claims to an equal range of power and freedom (p. xii).

This admission leads me to agree with Steinhart's (1972) fear that "our institutions are healthy, vigorous, and headed in the wrong direction."

In the schools the freedom of scientific investigation should be countered with the consideration of the social effects of this investigation, both in terms of the allocation of a community's resources toward a project and in terms of the desirability of the application of a product. All students of the school, not just the social scientist, should be made to consider these things. Debate, consultation and group decision making should be an active part of the curriculum, and a required part of the training in science education. As Schumacher (1973) notes:

> Science and engineering produce "know how," but "know how" is nothing by itself; it is a means without an end, a mere potentiality, an unfinished sentence... Can education help us to finish the sentence ... to do so the task of education would be first and foremost, the transmission of ideas of value, of what to do with our lives. There is no doubt also the need to transmit know how but this must take second place, for it is obviously somewhat foolhardy to put great powers into the hands of people without making sure they have a reasonable idea of what to do with them (p. 82).

PROPOSALS DIRECTED TOWARD TASK III: THE MODIFICATION OF A WORLD-CENTERED ACADEMIC EDUCATION TO ENCOMPASS THE PRACTICE OF UTILITARIAN SCIENCE

The students of science in a community-interaction school should, in the Franklinian sense, study those things that are useful. However, it is not a utility to industry that we will be concerned with, but a utility that arises out of the natural interests of the learner and his desire to create in his environment. This is a very important concern. The science educator in a community interaction school is primarily concerned with aiding the student to use the concepts and processes of science toward ends of value to community or school. Inasmuch as these concepts, processes and skills can be carried with the student to other communities, cities, villages, or schools, these talents will be useful wherever the student goes. The focus of the interactions of the school are thus intentionally local, and this is in part a rejection of the largely word-centered and highly specialized education that primarily benefits the larger national and international increasingly corporate social structure. This radical action is taken because if our present megatechnic society is suspect of producting unhealthy people, and judged to be not considerate of the full needs of man, then to gear instruction primarily to the production of skills marketable only in the present economy is to further insanity. The community-interaction

school is forced to adopt a curriculum of more local agrarian studies because it is with the ground level interactions, and the local community that the prospect of restructuring society lies. This restructuring cannot be instituted from the top down, from the national to the local level, because a sound national social framework does not exist. Though we have built a fantastic national network of product transfer and communication, largely via our attention to the powerful and often unbridled words of science and industry; we have never built, nor can we now easily build, the human element of this structure upon these foundations. Therefore the science teacher must focus his attention at local effects, for here is where his strength is. As Gailbraith (1971) notes, "there is so little prospect of overcoming the defects of the power system by any attack that employs mass organization and mass efforts at persuasion; for these methods support the very system they attack" (p. 408). The science teacher must turn to the gradual application of a science instruction that can produce locally useful products. He does this to help restore the student's sense of worth, and because the community is the only place where the teacher can realistically work.

The products of science instruction can be of two kinds. In community ground level product interactions, science instruction proceeds as students engage either in working with the earth and its elements to arrive at a product or tool that is of real, nearly immediate social

utility or in research to ferret out academic information that may be of value to the other members of the class or larger group. In line with the general nature of instruction of these schools, both parties are responsible for sharing their information with the participants of the school, and on occasion the larger community. The students may also be responsible for storing their results in a local or community library.

The role of the science teacher in this process is most important. He is to facilitate the above process, to organize the sharing of data, and when appropriate to draw upon his greater experience to demonstrate a unity or present a greater organizing concept of science that exists among the individual projects of the students. The student should be held firmly responsible for mastering the material presented by the teacher, and the teacher should strive to convey the relationship between the concepts presented and the task at hand. The teacher should present the integrating words and concepts of science to the student in relation to the student's work in the environment. The teacher should seek to expand the learner's awareness of the transcendant principles of science and to fuel the learners curiosity toward further study. Though the teacher may hold a student responsible for concepts presented, he should not inundate the student with this sort of information. In reports to the classes the student should be required to use the language of science, and to elucidate any concepts presented in a clear and

straightforward manner. The teacher should aid the students in their presentations by helping them formulate precise objectives for the instruction.

In a community-interaction school the evaluation of students consists of two facets: the teacher should consider the process of the students' interaction with their projects, and measure their performance achieved on testing over material presented by the teacher or other students in classes or seminars. If students help construct the testing instruments, it should be under the supervision of the teacher who will moderate the questions asked based upon the relative importance of the item and the effectiveness and clarity of the students presentation of that item.

Another facet of the ground level interactions in science instruction, is that the students should be familiar with the origin of the materials with which they are working. Ground level interactions require that a student know the ground level origin and the basic process of transformation of the student's starting materials. The student is not expected to synthesize his starting materials from scratch, but he should not be allowed to fall into the mentality that NaOH comes from the NaOH store, and food comes from the food store. This sort of thinking is not sufficient for a community that wishes its youth to break out of a consumer mentality, and be capable of fashioning a world more of their own design.

SIGNIFICANT OBSTACLES, SUGGESTIONS AND REASONS FOR PERSISTENCE

It is difficult to imagine a community-interaction school operating within the confines of current school practices. As should be obvious a number of changes should be made; however, there are significant barriers that lie in the way of such innovations. I will list some of these obstacles here along with a few brief suggestions for overcoming them.

1. The continued presence of a fifty minute class hour as a format of instruction. This format should be changed if possible to allow the students a more natural schedule to work on their projects. Within the confines of the present system, it may be possible for teachers to make compatible arrangements with other teachers and principals in the redistribution of their class schedules.

2. The practice of forcing teachers to adhere to a county curriculum guide. This practice should be relaxed in order to allow students the freedom to explore their own interests and learn to become their own masters. If progress cannot be made toward this objective, at least teachers should allow their students to choose from among the possible choices for study those topics that most appeal to their interest and allow students to give the presentations.

3. Lack of inexpensive, useful and available equipment, and the space for a project styled curriculum.

4. The lack, to date, of successful, local working models of the proposed curricula to help guide progress and meet frustrations.

5. The low level of rational, moral, and emotional maturity of the students, that makes beginning such tasks appear ominous for the teacher.

6. The presence of aloof or irrational parents, and politically anxious teachers, school boards, and administrators.

7. The lack of teachers that are trained in sufficient management and scientific skills to be of service to the students.

8. The continued presence of a college-dominated curriculum.

Nevertheless, as the teacher's motivation for attempting such innovations should come from the penetrating realization that our society and its citizens are in deep trouble, the need of the situation demands that the teacher rise up, perhaps alone and unaided, and try to meet in whatever way possible his social responsibility. However, the appropriate way to approach the students is not through an expression of fear and anxiety, or through trying to organize a mass exodus into the hills and country side, but through exposing alternatives, and offering a new set of skills. There are important social reasons for considering the proposed curriculum changes. One of these reasons is to preserve the range of options that lie open to our people in the future. The style of life that one chooses to live should not be totally determined by society, rather the society should remain flexible to the wants and needs of men. If our students learn only limited skills of production that are applicable in only one form of society, then we are condemming ourselves to only this option in the future. In all honesty, there may yet be another reason for fostering community/ground level interactions in the schools. In an age of potential world wide calamity, it may not be unwise for youth to become familiar with those basic community

level skills of survival. However, these are probably not concerns that we should stress with the youth. The battle in curriculum, as in society, is really a personal spiritual battle. It is a battle that each man must reckon for himself. It is not society that is to be attacked, such an attack wastes energy and scares people. It is a rebuilding that is needed, and it is toward this end that the proposed curriculum changes are directed. As Lewis Mumford (1970) noted, "the arch enemy of the Affluent (modern industrial) economy would not be Karl Marx, but Henry Thoreau" (p. 330). This is because Thoreau sought options outside of the framework of the system and did not dissipate his efforts in constant frustration.

The changeover to the proposed teaching strategy will not be easy. I fully believe that students are so numbed in their perceptions, so disbelieving of talk of change in the educational system, so thoroughly consummed by the blarring reality of the world around them and their desire to escape from parts of it into pleasure, fantasy or nature, that they will not easily take hold of the notions of freedom and social responsibility in education. Nevertheless, the teacher in changing instruction should be patient but persistent, innovative but wise, allow freedom but maintain control. Hopefully these changes will bear good fruit in the soul and society of man.

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